BOROUGH OF LIVERPOOL.

At a Meeting of the Council of the Borough of Liverpool holden by adjournment on Wednesday, 5th day of July, 1871

PRESENT:

JOSEPH GIBBONS LIVINGSTON, ESQ., MAYOR,

AND A FULL COUNCIL.

Read letter from Dr. Parkes and Dr. Sanderson, enclosing the first portion of their Report on the Sanitary condition of Liverpool.

Resolved—

That the same be referred to the Health Committee and printed, and a copy sent to each Member of the Council.

EXTRACTED FROM THE MINUTES,

JOSEPH RAYNER,

TOWN CLERK.

49, Queen Anne Street,

London, June, 1871.

The Town Clerk of Liverpool.

Sir,

We have the honor to forward to you the first portion of our Report on the Sanitary Condition of Liverpool. We regret that there has been so much delay, but as you are aware we have been waiting for the Census Returns which are necessary to enable us to give a reliable opinion on the causes of the Mortality of Liverpool.

Although we hoped to obtain these returns in May, we have not received them and fear that it will be yet several weeks before they will reach us. We do not think it desirable therefore to delay longer sending you the instalment of our Report which relates to the two special points which we were asked to investigate, viz: the material used for filling up ground and the ventilation of the sewers.

With respect to this last point we think it right to state that the charges brought by Mr. Bennett against the Municipal Officers, even if true, do not in the least affect any of our facts and conclusions. But in justice to the Municipal Officers we think it our duty to express a decided opinion that Mr. Bennett has fallen into error in supposing that the manholes were opened some hours before we entered the Sewers for the purpose of misleading us.

The preparations for our inspection were made in accordance with our own instructions so that we were perfectly aware of their nature. For the delay which occurred between their completion and our visit we are entirely answerable.

We will forward the second portion of our Report with the least possible delay when we receive the data from the Census Office.

E. A. PARKES, M.D., F.R.S.
J. BURDON SANDERSON, M.D., F.R.S.

REPORT ON THE SANITARY CONDITION OF LIVERPOOL, BY E. A. PARKES, M.D., F.R.S., AND J. BURDON-SANDERSON, M.D., F.R.S.

Introduction.

In December last we undertook at the request of the Corporation of Liverpool to make an enquiry into the Sanitary Condition of the Town.

The nature and extent of the inquiry were defined in Resolutions of the Health Committee and Town Council, with Copies of which we were furnished.

In these Resolutions, the subjects to be investigated were stated in the following words and order :—

1.—The present practice of filling up with ashes, land intended to be built upon. (Resolution of Health Committee, November 24, 1870).

2.—The state of the Drains and Sewers especially with regard to their ventilation and of the privies, water closets and ashpits.

3.—The system of Scavenging now adopted. (Resolutions of the Council November 24, 1870).

We accordingly proceeded to Liverpool on the 1st March, 1871, and on the following day attended a special meeting of the Town Council. The Chairman of the Health Committee then read an address which clearly set forth the points on which our opinion was desired. This address is given in the foot note below as well as the Report of the Superintendent of Scavenging referred to in it.*

Address read at the Meeting at the Town Hall, March 2nd, by Dr. Taylor, Chairman of the Health Committee.*

Drs. Parkes and Sanderson,

Gentlemen,

You who are practically acquainted with the many difficulties which are inseparably connected with the hygienic management of large towns, and with the total absence of any definite and fixed rules for such management, will not be surprised to know that various opinions have arisen in Liverpool as to the effect of the action of the Health Committee in reference :

1stly.—To the disposal of refuse and especially to that cinder refuse which is unpolluted with ordure and therefore useless as manure.

2ndly.—To the construction, ventilation, and trapping of the sewers of the town, and the injection into them of steam and water at a high temperature.

3rdly.—To the substitution of trough and syphon water closets in lieu of privies and cesspits.

It is therefore with a wish to satisfy public opinion on these three important questions that your scientific aid has been invited by the Council of the Borough.

I have received for your information from Mr. Reynolds, the Superintendent of Scavengers, a report on the mode of disposing of the refuse of the Town, and also a list and description of the pits, delfs, and brickfields which have been filled up in the mode mentioned in his

It was however desired by the Council that we should not confine ourselves to the points raised in the address, but should investigate the Sanitary Condition of

---

report. Mr. Reynolds has the orders of the Health Committee to show you these places and to facilitate in every way your investigations.

The subject is, in an economical and rate-payers' point of view, one of the greatest importance to Liverpool and other towns of Lancashire which may adopt the water closet system of sewage; since the disposal of valueless ashes is a difficulty very little less than the disposal and utilization of the sewage itself.

The Health Committee therefore desire to know whether there can arise, from their mode of removing and utilizing refuse, anything injurious to health;—whether the levelling of brickfields and the filling up of ponds, in the manner described by Mr. Reynolds will produce any appreciable amount of gases injurious to health, either at the period of the deposit of the materials used or after their consolidation into a firm foundation for houses.

Your opinion is also requested on the wider subject of the influence of the foundation of houses on the health of the inhabitants.

Many years ago, before the establishment of a Health Committee or the existence of any sanitary statutes, the refuse of chemical manufactories was largely deposited in the pits and brickfields situate at the north of the Town. These fields are now a populous district, and not only are many of its houses built on chemical refuse but its sewers have been obliged to be constructed through large areas of such material. As a natural consequence the sulphide of calcium will, in spite of every precaution, find its way into the sewers. Hence the evolution of sulphuretted hydrogen, especially where the sulphide meets the acid refuse of manufactories. This has been a long felt evil frequently brought before the notice of the Health Committee by their officers. The Council will be very glad if you can suggest any practical mode of remedying or abating this evil.

The central or older parts of the Town have no deposits of chemical refuse. The hollows left by the removal of brick clay were utilized as cellars or underground habitations. This portion of the town, contains the chief seats of epidemic fever; indeed the chief Typhus field of 1865, and the Cholera field of 1866, was all that portion of the town which stands on a subsoil of clay, being situate between the River and Scotland Road, along the course of the old Pool to the top of Whitechapel. The Council will be obliged if this part is also surveyed by you.

The Borough Engineer and the Medical Officer of Health have received the instructions of the Health Committee to co-operate with you in your investigations and the general public have been invited to give you every information in their power. The Council will also gladly place at your command all the necessary technical help required by you in the investigation of the sewers and the water closet system of the Town.

Report of the Superintendent of Scavenging.

The Superintendent begs to report that it is the rule in Liverpool to empty Dry Ashpits and remove the cinder refuse from houses supplied only with water closets during the day, whilst the contents of privies or ashes impregnated with human ordure are removed during the night.

To this rule there are three exceptions:

1st.—Ashes from offices connected with dwellings situated near the Exchange or chief business thoroughfares are removed during the night because their removal in the day time would interfere with the convenience of business men.

2nd.—Ashes which although contained in a Dry Ashpit are found to be of an offensive character are treated as night soil and midden refuse and dealt with at night.

3rd.—The contents of all Court Ashpits, that is pits common to a number of separate dwellings are treated as night soil and also removed at night.

All night soil and the contents of Ashpits treated as night soil are carted to the Railway Siding or one or other of the Wharfs and from thence are at once, without being deposited within the Borough, conveyed to farmers or to Depôts in the Country.

The contents of Dry Ashpits and the ashes collected by the dust carts are taken in the day

the town generally, with a view of offering suggestions for lessening the exceedingly high death-rato which has prevailed for many years.

Full power was given to us to conduct the investigation as we thought best, and accordingly we determined to examine into every point for ourselves and to take nothing on hearsay.

---

time and together with the sweepings of Macadamised roads are utilized for filling up disused Brick Fields, Quarries, &c. The operations of removing all the town refuse is superintended by the district scavenging Inspectors whose visits are sufficiently frequent to guard against any evasion of the Instructions issued by the Health Committee either by the negligence or perversity of the carter.

The road detritus used for filling up is taken from the outskirts of the Town and contains but a very small proportion of organic matter. The road scrapings obtained from the central thoroughfares, the sweepings obtained from paved streets and the refuse collected by the Barrow Men from the streets in thickly populated districts contain a considerable amount of animal and vegetable matter and therefore possess some commercial value, they are disposed of from the Wharfs to Farmers.

It is found that there is seldom any perceptible amount of Bones in the Ashpits for they and other substances having a commercial value are removed (if thrown into the Ashpit) by gangs of Boys and Women who search these places for whatever things can be sold.

Appended is a list of the principal places on which Dry Ashes have been utilized for filling up since January 1867, at which time the removal of the Town refuse was undertaken by the staff of the Health Committee.

Locality.	Description of place filled up.	Approximate Estimate of Loads Deposited.
Parliament Fields,	A Pond of Stagnant Water very offensive,	4,000
Moss Bank, Grove Park,	A Brickfield only partly filled (the place alluded to by Dr. Stallard) Brickfields	1,700
Tunnel Road, in two places,	1st place also complained of by Dr. Stallard,	2,000
North Hill Street, in various places,	Brickfield and Pits of stagnant water	10,000
Minto Street,	The same,	5,000
Poplar Street,	Dangerous Quarry,	15,000
Whittle Street, in two places,	Brickfields,	3,000
Westminster Road,	Ditto,	2,000
Cobb Delph,	Quarry,	2,000
Site of Zoological Gardens and vicinity, many places,	Pits, Stagnant Water and uneven ground	16,000
Podge Bank, near Grove Park,	Ditto,	2,000
Sefton Park, many places,	Uneven ground,	6,000
Great Mersey Street,	Brickfields and raising the land,	3,500
Sandhills, vicinity of stables,	For raising land to requisite height for building	6,000

The following are the places now in process of being filled up :—

Phythian Road,	Brickfields.
St. Domingo Grove,	Dangerous Quarry.
Hackthorpe Street,	The same.
Westminster Road,	Brickfields.
Stanley Road,	The same.
North Hill Street,	The same.

We met in our enquiry with the most cordial assistance from every officer of the Corporation, and we desire to express our grateful thanks for the help so constantly and so cheerfully given to us.

Section I.

On the practice of fillling up inequalities of ground with Cinder-refuse.

Liverpool is built for the most part on a bed of clay lying over red sandstone rock. The clay is very stiff and impermeable and has been largely removed for brick making. The inequalities thus arising, were formerly filled up with refuse derived from chemical works, and in other ways.

The pits produced by the excavation become usually half full of water and naturally receive the refuse of the neighbourhood. Dirty stagnant ponds or unsightly pits with refuse occupy several of the suburbs, and for the sake both of health and appearance, and for the utilization of the ground require to be filled up. The filling up is being done by builders refuse, by the rubbish got rid of by private persons, and by the cinder-refuse of the town.

It is quite clear that these inequalities of ground must be got rid of, and the question is how this may be best done without injury to health. The use of cinder-refuse is said by its advocates to have the advantages of giving a dry firm subsoil, in which all organic matters are gradually got rid of by slow decomposition, so that on sanitary grounds alone they advocate its employment. But the plan has, they allege, an immense collateral advantage; it enables the Town to get rid of its ashes and house refuse, and in this way to meet a difficulty which is every year becoming greater. In London the ashes and refuse from houses are disposed of with little difficulty; the cinders are used by brick makers, the other articles are sorted and find a market. In Liverpool where coal is cheap the cinders are unsaleable and useless. Since the introduction of water-closets, no excrement is mixed with them and they have therefore no agricultural value. They must be transported from the town at the expense of the town, and as the cost is already great any additional expense of carriage would increase a burden already felt to be very heavy.

On the other hand the use as foundation for houses of cinders supposed to be largely impregnated with animal and vegetable refuse, though not with excrement, is considered by some to be dangerous in a high degree to the public health, and it is supposed that the welfare of generations to come may be im-

perilled by a false economy which purchases present exemption from taxation by throwing the burden on future years.

It will be seen that the point is one of very great importance to Liverpool and merits the most careful study.

The source and nature of the material used for "filling up" may be learnt from the Report of the Superintendent of Scavenging. It consists first of the contents of such ashpits as are regarded by him as inoffensive, and secondly of the sweepings from the macadamised roads in the higher parts of the town.

We are assured that it contains no excrement except that which may be included in the road scrapings at the outskirts of the town. The contents of all Dust-bins which appear to be offensive, as well as the scrapings of the paved streets in the central parts of the town are removed at night by Canal.

We visited various places where the process of filling up is going on, and we collected from six places fair samples of the deposited refuse. We also saw the method of collecting and removing the ashpit collections as well as the plan of removing the midden refuse.

The first point was to see of what the cinder-refuse consists, and the second to determine the effect which a soil made of it would have on the health of the people living over it.

Composition of Cinder-refuse.

The samples collected were numbered in the order of their collection, but in the following list we have arranged them in the order of the date of deposit, placing the most recently deposited first.

In all cases the samples were fair specimens and were taken from 3 to 5 feet below the surface, except in the case of No. 1 which was taken from the surface.

DEPOSITS OF CINDER-REFUSE.

No.	Place whence taken.	Date of laying down.	Length of time the refuse had been laid down when taken.
1	Old Brickfield, Phythian Road.....	9th March, 1871.	One day.
2	Tunnel Road.....	October, 1870.	5 months.
3	Grove Park, Toxteth Park	September, 1870.	6 months.
4	Phythian Road	February, 1870.	12 months.
5	Site of Reservoir, Old Zoological Gardens	June, 1868.	32 months.
6	Zoological Gardens.....	February, 1868.	36 months.

The deposits were found to consist of cinders varying from the size of a pea to that of a large nut or bean or sometimes larger; of smaller cinders which were however quite recognizable; of a powder composed in part though not altogether of cinders, and of other matters. They were therefore separated into these four classes and the following gives the percentage composition of each class.

Percentage of large and small cinders, powder and other matters.

No. of sample.	In 100 lbs.			
	Large Cinders.	Small Cinders.	Powder.	Other Matters.
1	60.71	10.71	17.85	10.71
2	50.00	10.00	30.00	10.00
3	41.66	20.83	29.16	8.34
4	60.30	15.15	48.48	6.06
5	20.47	8.82	67.64	2.94
6	58.27	10.48	25.64	5.59

The "other matters" consisted of the following substances: about 8 ounces of each sample being taken and all the "other substances" picked out.

Other matters of—

No. 1. Pieces of potato; peahusk; bits of wood; bits of straw; paper; blotting paper; bit of bone; textile fabric; some hair.

No. 2. Pieces of wood shaving; rotten straw; broken crockery; rotten potato parings; burnt bone; a few pieces of old rotten woollen cloth; pieces of egg shell; stone; pieces of rotten paper.

No. 3. Feathers; bits of paper; rotten straw; little bits of rotten stick; bits of rotten potato; potato paring; bits of shell; small piece of brick; pieces of glass.

No. 4.—Rotten straw, fish bone, rotten potato parings, broken egg shells, a stone, a few pieces of unburnt coal, some bits of charcoal, some soft little pultaceous matters, usually coated with cinder dust and without smell till crushed, but then very offensive.

No. 5.—Pieces of glass, small stones, rotten straw, rotten pieces of wood, a little bit of solder. No potato parings but some small dark lumps which are evidently of organic origin but are quite free from smell and though

otherwise resembling them differ in this point completely from the similar lumps in No. 4.

No. 6.—Pieces of egg shell; cockle shell; pieces of glass; a stone; rotten straw; piece of crockery; piece of slate; pin; two pieces of rotten wood; two pieces of decayed bone; rusty nail; a little bit of rotten woollen cloth.

The "other matters" included in no case excrement, but simply the substances which naturally form part of the dry refuse of houses. The examination made it quite clear that bits of potato and other vegetable matters gradually decomposed. Distinctly recognizable in No. 1, 2, & 3, where they were all coated with ash, in No. 4 the bits of potato had taken the form of soft pultaceous masses, inodorous till broken across but then highly offensive. In No. 5 the same masses existed but were inodorous, while in No. 6 no such masses were found. As they must have been present at first it may be concluded that they were entirely broken down.

Potato and other vegetable and probably animal matters become then first coated over with fine cinders and are soon made inodorous till crushed; after 13 months they lose their character but are still offensive; while after 2 years and 8 months they are farther changed and lose all odour. In 3 years potato and all vegetable matters of that kind, have entirely decayed away; straw, wood, cloth, &c., though very rotten had not entirely decayed in 3 years.

The sense of smell confirmed these conclusions. The smell of No. 1 was very offensive; of Nos. 2 and 3 the smell was much less, while Nos. 4, 5, and 6, were perfectly devoid of smell except that given off by rather moist cinders.

We conclude then that the process of decay of all the most easily destructible matters is completed in 3 years, how long the wood and woollen cloth would remain recognizable we cannot say, probably for many years.

So much for the "other matters." Of the 3 other classes the large and small cinders require no further examination.

The "powder" was a dark colored, rather moist substance; under the microscope it presented no marked character, it was evidently in part composed of fine ash and cinders, and in part of earth, there were no living animals or plants in any case.

When incinerated and all the carbon burnt off, the remainder consisted of a reddish earth containing large quantity of iron and evidently derived from road sweepings.

The following table shows the composition of the powder, in 100 parts ; the solids, the water and the indestructible substances being given, the latter consisted of the ash of coal and mineral matters from the road sweepings.

Composition of Powder.

	In 100 lbs.					
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Solids.	74.8	62.9	82.	76.3	82.6	73.5
Water.	25.2	37.1	18.	23.7	17.4	26.5
Ash and mineral matter left on incineration.	37.8	52.	45.8	56.96	66.78	47.4

In order to determine the amount of the nitrogenous constituents of the powder the following plan was adopted. The total nitrogen was estimated by burning with soda-lime; the amounts of ammonia and nitric acid were also determined by washing 1 part of the powder in 100 parts of cold distilled water and then determining the amount of the ammonia by distillation with caustic soda and of nitric acid by the Schultze-Wanklyn process.

The following table gives the results.

Table to show the amount of ammonia and nitric acid and nitrogen as determined by burning with soda-lime.

No.	In 100 parts of the "Powder."		
	Ammonia.	Nitric Acid (HNO_3)	Nitrogen by burning with Soda Lime.
1	·00422	·1034	852
2	·00164	·0275	·390
3	·00138	·0545	·497
4	·00512	·0411	·426
5	·00180	·0470	·177
6	·00160	·0285	·372

The object of these determinations was to see first whether the powder was largely contaminated with nitrogenous substances or their derivatives, and whether in process of time any amount of purification had taken place.

The analyses showed much organic impregnation, and also that ammonia and

nitric acid were present in some though not in great amount.* They proved also that the refuse just laid down was much richer in all these substances than the deposits of older date, but there is no evidence of regularity of purification. For example No. 2 refuse which had been laid down 5 months had exactly the same composition as No. 6 which had been down 3 years.

Of course it is impossible to be certain that when laid down each powder had the same composition, and it is indeed almost impossible that they should have had. Therefore any experiments of this kind are liable to fallacy. Still looking to the amount of nitrogen of No. 1 and No. 5 and 6, it appears reasonable to conclude that a slow process of formation of ammonia and nitrites and nitrates did go on and that the latter were washed out by rain.

That some decomposition went on in the soil was also shown by thermometrical experiments. A thermometer inserted in the deposit at Grove Park, 5 feet from the surface, marked 16° Fahr. higher than a thermometer inserted in sand at the same depth. At Phythian Street the thermometer in the deposit marked 2½° more than in sand.

Whatever may be the nature of this slow decomposition it did not appear that it produced any sulphuretted hydrogen, or other gas, or disagreeable vapour detectible by smell. But doubtless effluvia of some kind would be produced.

Such then is the composition of the cinder-refuse. The greatest part is really cinder or earth and is quite innocuous, but there is some vegetable and animal matter, and organic road debris which gradually decays. And looking to the very small quantity of ammonia, nitric acid and nitrogen existing in Nos. 5 and 6, it may be concluded that as in the case of the potato about 2½ or 3 years suffices to produce a considerable purification of the soil.

With respect to the influence of this cinder-refuse on the health of persons inhabiting houses built on it, the evidence is very defective. The refuse has only lately been used and as it certainly does not produce any one special disease, it would be impossible without prolonged and careful comparison of the health

*Dr. Heisch was kind enough to determine the solids, water, and nitrogen in three samples and his results are :—

No.	In 100 parts.		
	Solids.	Water.	Nitrogen.
1	72·86	27·14	·696
4	75·38	24·62	·300
6	76·64	23·36	·450

of those living on it, and of classes of the same rank and occupation living on other soils to give an opinion. For such a comparison there are no materials, and we are obliged therefore to fall back on general principles. We can have no doubt, that from a soil formed of such cinder-refuse and gradually decomposing, some effluvia must be given out which would be likely to pass into houses placed on the soil, and therefore, that on the general principle of requiring and ensuring purity of air, such a soil is objectionable, at any rate when first laid down.

Accepting this view and looking to the analysis of the cinder-refuse we advise the Town Council to adopt certain rules, which if strictly carried out will obviate the objections raised to the cinder-refuse as foundations for houses.

1.—No excavation should be used for the reception of cinder-refuse unless it is efficiently drained. This appears to us to be of special importance in relation to the filling up of brickfields. It is well known that the whole of the surface of clay is never removed, and there is always sufficient to form an impermeable basin in which, in the absence of drainage, water constantly collects. We hold it to be of the greatest importance for the rapid decomposition of whatever offensive material may exist in the "cinder" that it should be able to become dry. The only way in which this can be promoted or secured is by efficient subsoil drainage.

2.—As the vegetable and animal matter contained in the cinder-refuse decays and disappears in about 3 years, and is virtually innocuous before that time we recommend that places filled up with cinder-refuse shall not be built upon for at least 2 years from the date of the last deposit.

3.—We are well aware of the difficulty of disposing of the road scrapings, but we would advise that inquiry should be made as to the practicability of getting rid of the scrapings in some other way in the place of mixing them with the cinder-refuse.

4.—We think that the scavenging department should have very strict rules with regard to the selection of material. Much greater care should be taken by the District Scavenging Inspectors than is the case at present, and the Superintendent should hold them responsible.

It should be inquired also whether some system of sorting could not be resorted to and the more offensive matters picked out. It might be possible to employ the paupers in the Workhouse for the purpose, or to authorize small payments to the persons who now make a living by raking over the cinders after deposit, for such vegetable and animal refuse as they can pick out. Of course any such sorting would have to be done under some kind of supervision.

In leaving this subject we must remark that in some cases filling up of excavations is being carried on by private parties, and in some instances with materials more offensive than those employed by the Town Authorities. We think all deposits of this kind should be inspected by the proper Town Officers acting under the orders of the Health Officer, and that whenever the deposit is of such a nature as to be a nuisance injurious to health, as defined by the Nuisances Removal Act, proceedings should be taken before the Magistrates with a view to abatement.

Section II.

On the practice of filling up with Chemical Refuse land intended to be built upon.

Some portions of the Town are built on the refuse of the Chemical Manufactories (of carbonate of soda), which formerly was largely used for filling up. We obtained two samples, one from Townsend Street, and the other from Bentinck Street, at a depth of about 6 feet from the surface.

The refuse is the insoluble residue after the carbonate of soda has been dissolved out of the "black ash." It consists principally of lime and carbonate of lime, with some sulphide of calcium, coal and sand.

Sulphuretted hydrogen and carbonic acid are liberated by acids, but, in the two samples obtained by us, no disengagement of sulphuretted hydrogen takes place from the action of the atmosphere alone.

From the personal inquiries we made, it appeared to be clear that in some of the houses built on ground made of this refuse, the smell of sulphuretted hydrogen is distinctly perceived and is a source of great discomfort. On inquiry we found that the gas entered the houses from the sewers and did not pass up from the ground below, and this was confirmed by finding that the air in the ventilating sewer shafts contained a large quantity of sulphuretted hydrogen. From what has been said it is clear that the disengagement of this gas cannot be attributed to the mere action of air on the chemical refuse, but is only produced by contact with acid liquids. We believe, there is no reason to doubt, that such acid liquids do exist in the sewers between Vauxhall Road and the Mersey, and that these are derived mainly if not exclusively from certain chemical works in that neighbourhood.

The remedy is clearly to exclude from the sewers one or other of the two substances from the meeting of which the gas is evolved.

We gather from the statement of the Chairman of the Health Committee "that the sulphide of calcium, will, in spite of every precaution find its way into

the sewers," and if this be so, the only remedy will be to prohibit the passing of acid liquids into the sewers.

We recommend that exact information should be obtained into the source of the acid liquid, and that proper provision should be made for its discharge into the Mersey without entering the sewers.

As to the question whether the expense of providing such additional drainage ought to fall on the Town or on the manufacturers, the Corporation will, of course, be guided by the opinion of their legal advisers.

We understand that the use of chemical refuse for foundations and for filling up is at present prohibited. While advising the Corporation to persist in this prohibition, we are of opinion that in those parts of the town in which the houses are built on chemical refuse, the public health is not likely to be injuriously affected by the fact. For apart from the Sulphuretted Hydrogen there is nothing in the soil which can affect health; it is entirely mineral, and if any animal or vegetable matters should pass in they would be destroyed by the lime. And as the evolution of Sulphuretted Hydrogen only occurs under certain conditions, health will not be affected if those conditions can be avoided.

Section III.

On the Condition of the Sewers.

Before making any observations on the question submitted to us we think it necessary to state from what sources our information is derived.

Our own survey of the interior of the Liverpool Sewers was limited. The day after our arrival, we examined the plans of the sewers and received from Mr. Newlands explanations on all points relating to their construction and arrangement on which it seemed desirable that we should inform ourselves. We then selected several sewers for inspection and made arrangements for entering them in company with Mr. Evans the following day. We found however that of those selected we had only time to accomplish the examination of two, viz., those of Richmond Row and Duke Street. It will therefore be understood that the statements relating to the ventilation of the sewers and the existence of deposits in them are founded on information obtained by other modes of inquiry.

As regards the existence of deposits it is obvious, considering that Liverpool contains more than two hundred miles of sewers, that even if our inspection had been ten times as extensive as it was, we could have formed no opinion from personal observation. We therefore requested the Borough Engineer to be good enough to furnish us with a complete return of all those sewers known to be in a foul state. This document which we append to our Report will we trust form the basis of further inquiries.

As regards ventilation our conclusions are formed partly on our own observations, partly on information communicated to us.

So far as relates to the actual movement and pressure of air in the sewers and to the working of the Archimedean Ventilators, we have depended exclusively on our own experiments; but we have been indebted to the Officers of the Corporation for complete information as to the construction of the inlets, the form, capacity, and inclination of the sewers, the manner in which the outlets pass under the docks, the arrangements adopted for preventing the ingress of tidal waters, and all other constructive details with which it was necessary that we should be conversant in order to judge correctly of their possible influence on the movement of air.

Throughout our investigations of the sewers we were much struck with the difficulty of access. In order to enter the sewers we inspected, it was necessary in each case that the ground should be previously opened in the middle of a street, in consequence of which, as the ground was open for some time, the traffic was seriously interfered with. As with such a system, efficient and frequent inspection seems impossible, we think that proper side entrances should be constructed in sufficient numbers to enable the men to enter the sewers without difficulty, as recommended more than twenty years ago by Mr. Newlands (Vide Report of the Health Committee, 1848, page 80.)

Ventilation of Sewers.

Under this heading we propose to consider those appliances which have for their object to prevent the contamination of the air breathed by the inhabitants of a town with sewage emanations. The efficiency of these means must be judged of, first by a careful consideration of the purpose they are intended to answer, and secondly by the accurate observation of the results obtained by their use. The purpose has been already stated. For its accomplishment, the first requirement is that there should be no air-communication whatever between inhabited houses and sewers or drains; and the second, that the air contained in the sewers should be at all times so diluted with common air, that when, as must always be the case more or less, it escapes into the streets, it may be as little injurious as possible. We have therefore to consider with reference to each of these two requirements in how far it is satisfied by the arrangements actually in existence in the town of Liverpool.

We regard the prevention of the entrance of sewer air into houses as an object paramount to every other in importance; for it is a matter of general medical experience that even a fractional contamination of the air of a sleeping

room is almost certain to produce disease sooner or later; whereas we know that in many towns (as *e.g.* the Metropolis) the air of the streets is polluted to a very considerable extent without any apparent detriment to the public health.

There are two directions in which our efforts to keep this dangerous intruder out of our houses must be made. On the one hand the drains by which the solid and liquid refuse is discharged into the sewer should be so constructed as to be impervious to air; on the other the condition of the air in the sewer itself should be such that if apertures exist, the external air shall rather tend inwards than outwards,—rather to enter the sewer by them than to escape.

As regards the construction of house drains and of the modes of trapping them efficiently, we do not propose to occupy space. We have had the opportunity of examining the excellent house drains which have been constructed by your officers in the streets inhabited by the poorest classes, and shall again advert to them in the section of this report which relates to the sanitary condition of those streets.

But this is the place to notice that the house drains in many of the courts open into the cellars, and, as is well known, the traps are often in such bad condition from the improper treatment they receive from the inhabitants, that practically the house and sewer are in direct communication. This is a matter requiring instant attention, and we believe that the proper course would be to alter the plan *in toto*; to insist on all inlets being placed outside of the houses in such positions that they can be easily inspected and repaired. This would necessitate in some cases a change in the arrangement of the water supply. In the other parts of the town, where the houses are inhabited by persons in superior circumstances and beyond the reach of official inspection; we cannot doubt it often happens that in Liverpool as elsewhere, the traps are so defective that they afford no safeguard whatever against the evil they are intended to prevent, or that the drains themselves are constructed of porous materials and in an imperfect manner.

For this reason the first of the two requirements with which we started, viz :— the prevention of air communication between the houses and the sewers, is beyond the control of the local authority, whose efforts must therefore be *mainly directed to keeping those drains which are under their own management in such condition as to render the defects of private drains as little dangerous as possible.* Granting that defects (*i.e.* communications between houses and sewers) will often exist, any means of sewer ventilation employed will be useful in proportion to its efficiency as a means of promoting draught from the houses towards

the sewer. In some parts of Liverpool, especially in those parts which are inhabited by the poorest classes, it has been sought to accomplish this object by the erection of ventilating shafts. To the working of these ventilators, and to the question of their practical utility, we shall devote a special section; but for the present confine our attention to those streets where no ventilators exist.

In these streets all communications between the sewer and the atmosphere are ostensibly closed, for of the two kinds of tributaries by which the sewers receive their solid and liquid contents, viz:—house drains and gully drains, both are supposed to be trapped. As regards the former we have already given reasons for believing that the supposition differs widely from the reality; but with respect to the gully grates we have no doubt from the inquiries we have made, as well as from the inspection of the inlets in certain streets, that the proposed object is fully and efficiently carried out, and that the traps in question are really all that they profess to be.

If the state of occlusion which some persons seem to think desirable, were practically attainable, *i.e.* if it were possible to close all the apertures which exist between the interior of the sewers and the external air, the state of things which would result would be attended with the greatest danger. Sewer air would from time to time be driven into houses with a force which no ordinary trap would be able to resist. Fortunately however, sewers, from the porous nature of the material of which they are constructed, can never be regarded as air-tight receptacles, so that although the pressure of the air contained in them may be momentarily raised above that of the atmosphere, equilibrium is very quickly re-established. For this reason there is practically no danger of the entrance of sewer air into any house, of which the stoneware pipe service drain is properly constructed, and closed at the inlets with ordinary water traps in good order.

Special measures for ensuring the dilution of the air contained in the sewers are chiefly required in sewers which contain deposits. In those which are in good order, *i.e.* in sewers so constructed, that with a sufficient flow of water (by which we mean a supply amounting to not less than 30 gallons per day per inhabitant), the channel will remain perfectly free from solid deposits, there is we think no necessity for the employment of any special apparatus. It is well known that in the interior of any sewer which is in the condition we have supposed, the air is so little polluted that even persons who are not habituated to sewer-air may remain in it for hours without any present discomfort or subsequent injury, the reason being that the quantity of sewage is

small in proportion to that of the water with which it is diluted and covered. It can scarcely be supposed that all of the Liverpool sewers are in this satisfactory condition, so that although we are inclined to believe that Liverpool may be favorably compared in this respect with other towns and even with London, it is not the less necessary to consider the case of those streets in which the sewers are constantly foul, either because they are built in the antiquated form which was employed many years ago, or because their inclinations are insufficient. In all such cases we think that immediate measures ought to be taken to remedy the fundamental evil either by the construction of new sewers or by altering the levels; and that in those cases in which it is impossible, for engineering reasons, to avoid having sewers of deposit, the special means to be hereafter described should be adopted for ventilating them, *i.e.* for diluting the air contained in them with as large a portion of fresh air as possible.

Before proceeding to state the practical recommendations we are disposed to found on these considerations, we shall discuss some special questions which have been raised, and which bear more or less on the subject. These are

(1) The effect of the closure of the sewer outlets;

(2) The effect of the entrance into the sewers of large quantities of warm water from manufacturers;

(3) The effect of discharging steam and water at a very high temperature into the sewers and,

(4) The efficiency of the Archimedean ventilators.

I. Closure of the Outlets.

It is well known that most of the outlet sewers pass under passages of the Docks by means of syphons before discharging their contents into the river, that consequently although they allow of the free passage of liquids, they are at every state of the tide, effectually closed so far as relates to the passage of air, and that, excepting in extremely low tides, the mouths of the sewers are always under water. It has been supposed by some persons that this state of things instead of being advantageous is dangerous because it interferes with ventilation ; it is imagined that a sewer through which there is not a thorough draught from end to end must be in a very unsatisfactory state, and that therefore effectual measures ought to be taken to provide for the remedy of so serious an evil.

Although on general principles we regard the apprehension which has been felt on this subject as absolutely groundless, it appeared to us necessary to satisfy ourselves by actual obscrvation that neither the occlusion of the outlet

nor the fluctuation of the tide exercise any influence whatever on the ventilation of the sewers. For this purpose we selected the sewer* which appeared to us more likely than any other to be affected by these causes, viz. that branch of the Gower street sewer which receives the drainage of the streets in the immediate neighbourhood of the Custom-house.

The reason why this sewer was selected will be apparent from the accompanying diagram in which it will be seen that the sewer and its tributaries form a system of themselves entirely unconnected with any others. In this sewer as elsewhere, the level at which the water stands varies with the state of the tide. At the man-hole in Canning Place, the point selected for observation, the sewer is quite full at high water, even when the tides are low. When as occurred at the time of our inspection the tides are unusually high, the water rises in the shaft to 2 or 3 feet above the crown of the sewer, so that it fills not only the sewer itself but all its tributaries. Here then is a sewer the ventilation of which if any must be certainly affected by the influx and efflux of the tidal water. The method we employed of testing it was simple but accurate. With the kind assistance of Mr. Evans we fixed above the shaft a water-manometer or gauge which was connected with the interior of the sewer by a vertical leaden pipe which passed down the shaft. The shaft having been carefully closed in such a manner that there was no other communication between the interior and exterior excepting through the leaden tube, a series of observations were made, which extended over 4 days as to the condition of the air contained in the sewer while the water was flowing and ebbing. The results were as follows.

On March 9th high water being at 1h. 3m. pm., the tension of the air in the sewer was shown by the gauge to differ very little from that of the atmosphere during the rise of the tide. *If anything it was rather less.* On the following day the two columns were level during the same period. On the 11th there were slight differences but these were not only inconsiderable in themselves but were evidently accidental, the pressure being sometimes greater outside, sometimes inside. During the period of ebb, the results were so similar to the above that it is scarcely worth while occupying space in stating the details. There was on the first day a slight tendency to in-draught at the beginning of the ebb but it was trifling and so temporary that it was evidently dependent on accidental circumstances. On each day the moment at which the water reached the crown of the sewer was indicated by the ejection of the water from the gauge; and this happened again and again during the height of the tide.

---

* See Plan of Canning Place Sewer in Appendix.

The results of the experiment were precisely what might have been anticipated. In consequence of the innumerable channels permeable to air by which the interior of a sewer communicates with the exterior, and the relative slowness with which the tide rises and falls, the displacement of air during flow, and its replacement during ebb has no appreciable influence.

So far therefore as relates to ventilation, the closure of the outlets and the filling of certain of the sewers by the tide are matters which deserve no consideration.

2.—Discharge of Warm Water into the Sewers.

On the 26th of April one of us had the advantage of an interview with a Committee of the Liverpool Chamber of Commerce on this subject, in presence of your Chief Magistrate. The gentlemen who were present on that occasion, who represented many of the most important manufacturing firms in Liverpool, afforded us very valuable information with reference to the enormous extent to which the practice of discharging warm water into the sewers prevails. It appeared that without taking into account any other Manufactories excepting those whose representatives were actually present, no less than twenty-five million gallons enter the sewers weekly ; of this quantity the greater part is water which has been used for the purpose of condensing steam and is discharged at a temperature which varies from 80° to 100° Fahr. The remainder is derived from the Sugar Factories and has been used for washing the animal charcoal after its employment for the decolorization of sugar. Thus water enters the sewers at a temperature of not less than 110° Fahr.

We were further informed that nearly the whole of this enormous quantity of water was derived, not from the water supply mains, but from private wells, whence the important fact is arrived at that in addition to the 10,000,000 gallons of water which daily pass down the sewers derived from the ordinary sources of water supply a relatively large quantity is conveyed by them derived from the Manufactories ; so that the whole discharge if the accuracy of this statement is to be relied upon, amounts to fourteen millions daily or about 26 gallons per head per diem.

After our interview we availed ourselves of the opportunities which were obligingly offered to us of visiting the principal manufactories. The main purpose of our visit was to ascertain more precisely in what way the discharge of warm water is regulated, for it was apparent to us that, although under any

circumstances the practice could not fail to exercise a very material influence, the degree and nature of that influence would largely depend on the regularity or irregularity of the flow. An agency which is constant may, even if deleterious, be counteracted by suitable measures, but it is very difficult to provide against the ill effects or to avail oneself of the good effects of a cause of which the operation is occasional and irregular.

The general result of our enquiries on this head was that although in the smaller manufactories, condensation-water is discharged only during working hours and is often interrupted, in the larger works the flow takes place day and night. In every instance however there are some important irregularities. In addition to the stoppage of work which occurs on Sundays, there is even in the largest factories a considerable diminution in the rate of discharge during the night, so that on the whole we cannot regard the flow to be, even under the most favorable circumstances anything like uniform.

We think that there are two ways in which the practice in question may have an influence for good or evil on the health of the town. It may act either by producing and maintaining a high temperature in the sewers, and thereby materially accelerating putrefactive decomposition of their contents, or by altering the relation of barometic pressure between the interior and the external air.

With regard to the first of these points, it is not possible to speak decidedly. It does not however appear to us to admit of doubt that the putrefactive process will go on much more rapidly in a sewer which is irrigated with water at a temperature of 60° to 80° Fahr. than in a sewer of the temperature of the air; and further that the development of living beings of low organization will take place more rapidly and in greater abundance than under ordinary conditions; and we are disposed to believe that at all events in certain states of the external temperature they must exercise an important influence in the production of disease.

The second point is more immediately within reach of investigation. As a basis on which to form an opinion, we made observations on the ventilation of two sewers which appeared to us (after consulting with Mr. Evans) most likely to be affected by the discharge of warm water. We selected for the purpose the Beckwith Street Sewer* and the Sewer in Vauxhall Road, the

---

* See Plan of Beckwith Street and Pownall Square Sewers in Appendix.

former as being in immediate communication with the sewer which receives the discharge from the works of Messrs. Heap and Co., (1,000,000 gallons weekly) the latter as being indirectly affected by the numerous manufactories in the neighbourhood.

These observations were made on the same days as those we previously referred to in Canning Place and by the same method. From the results obtained in Beckwith Street we learnt that during certain hours of each day air was injected into the sewers by pulsations, which recurred at intervals of about 26 per minute. Of the quantity of air injected we could, by the mode of investigation employed, form no judgment, but we inferred that it was considerable from the fact that at each stroke the water column in the open limb of the manometer was jerked up to a height which varied from 2 to 5 tenths of an inch, instantly regaining its former level. On both of the days on which the observations were made it was found that the pulsations ceased about six o'clock in the evening, and that in consequence the state of ventilation of the sewer was materially altered. The pressure inside of the sewer which had previously been slightly in excess of that of the atmosphere, (about a tenth an of inch) was now in defect. The difference was very considerable, amounting on the 9th and 10th of March to nearly an inch. On the following day (Saturday) when notes were taken of the state of the gauges in our absence the readings were similar.

At our subsequent visit to Liverpool in April, we had the advantage of inspecting the works of Messrs. Heap & Co., under the guidance of one of the members of the firm, who was kind enough to give us the fullest explanations of their mode of working, so far as relates to the discharge of air and water into the sewers.

We learnt that in the sugar factory a powerful air pump is employed for the purpose of exhausting the vacuum pans, and, that the air discharged by this pump is conveyed along a large main into the sewer, and that its strokes are at the rate of about 26 per minute. We further learnt, as has already been stated that the discharge of warm water from the sugar and rice works although it varies in quantity per hour is always taking place, so that the sewers leading from the works are always flooded with water at a temperature varying from 100° Fahr. to the ordinary temperature according to their distance.

From these facts, taken in connection with our previous observations, we conclude that the general effect of the constant discharge of warm water into a sewer is to increase the in-draught, by diminishing the tension of the air in its

interior. When the air pump was at work this effect was neutralized, but whenever it was not working it was always found that a difference of pressure existed in favour of the atmosphere (*i. e.* the external air was drawn into the sewer) which on one occasion exceeded an inch and seldom fell below six-tenths, so that the effect of the warm water in increasing the in-draught appeared to be about twice as great as the antagonistic effect of the pump.

The observations on the Vauxhall Road Sewer were not calculated to give so direct an answer to our question as those in Beckwith Street, for the influence of manufactories on that sewer is comparatively indirect. The difference between the pressure of the air in the interior of the Vauxhall Road Sewer and that of the atmosphere was relatively very small. Twenty-three observations recorded during the 9th, 10th, 11th, and 12th of March, give an average of 0·1 inch in favor of the atmosphere, the greatest difference ever observed being 2½ tenths. Eight readings were in favor of the sewer, the remaining 15 in favor of the atmosphere, so that on the whole there was a preponderence of in-draught

These results are in our opinion entirely dependent on the large quantity of water which is discharged, and the rapidity of its flow; for it is well known that in all sewers in which there is a strong and rapid stream, a current of air is produced which is in the same direction as the water stream, and is *cæteris paribus* of proportional velocity. In a word, the in-draught at the inlets is due to the down-draught in the sewer.

We are therefore of opinion that the introduction of a large quantity of water into certain sewers which receive the drainage of manufactories, in addition to its obvious utility as a means of preventing deposit, may also be useful as regards ventilation, and that if the flow is constant, the ventilating effect will not be interfered with by the temperature at which the water is discharged. As before stated we think it not unreasonable to suppose that this benefit is likely to be overbalanced by the danger arising from the accelerated decomposition of the sewage, but in addition to this there is another ground of objection to the practice we are now considering, which although it has not yet been adverted to, is in the present state of the sewers in Liverpool of very great importance. We refer to the difficulty which the existence of warm water in the sewers puts in the way of frequent inspection. In consequence of the saturated condition of the air and the high temperature, no warm sewer can be entered unless it has been open to the air for some time previously; consequently no

such sewer can be inspected without the expenditure of much time and labor in the preliminary preparations.

3. Discharge of Hot Water and Steam into the Sewers.

On this subject we do not think it necessary to occupy much space. The "blowing off" boilers into the public sewers is so obviously improper, that we suppose that no one who has given the subject any attention will be prepared to defend it. When a boiler is "blown off" its contents enter the sewer at a temperature not much below the boiling point. Consequently the pressure on the interior of the sewer suddenly rises, and the air, aqueous vapour and gases it contains are forced out by the readiest outlet, *i.e.*, into the houses. We have the strongest ground for believing that the practice prevails pretty extensively, and do not hesitate to say that it ought to be prevented. For although in a sewer which communicates freely with the air, the effect of blowing off a single boiler must be of short duration, it can never be free from very serious objection. In the comparatively closed state of the Liverpool sewers the effect of the process must of course be much more serious.

4. The Archimedean Screw Ventilators.

We shall first show by experiment that the Archimedean Screw Ventilators really do the work which they profess to do, *i.e.*, that they actually remove a large quantity of air from the sewers. We shall then state the reasons which have led us to the opinion that notwithstanding their mechanical efficiency they exercise no practical influence in preventing the escape of sewer air into the streets and houses.

The Archimedean Screw Ventilators were examined on the 4th March, at the corner of Henry Edward and Fontenoy Streets, and on the 10th March in Townsend Street. In each case an anemometer was placed in the bottom of the shaft and the external opening was then closed. The experiments on the 4th March were less numerous than on the 10th and gave a considerably less movement of air. As our opinions is not favourable to the ventilating power of these shafts, and as therefore we wish to give the experiments which were most favourable to them, we do not think it necessary to give in detail those made on the 4th March.

The Townsend Street shaft has a height of 71 feet from the place where the anemometer was placed to the top; the wind was blowing rather gustily at 7 miles per hour, over the top of the shaft and at rather less rate in the street.

Ten observations were made with the screw working as usual, 10 with the screw stopped and 10 with the screw removed.

Townsend Street Shaft.

No.	Upward movement of air in feet per minute.		
	Screw acting as usual.	Screw stopped.	Screw removed.
1	410	412	268
2	549	354	437
3	417	417	427
4	379	361	323
5	466	365	420
6	601	426	403
7	473	318	299
8	461.5	347	288
9	433	405	353
10	437	365	254
Mean.	462.65	377	347.2
Miles per hour.	5.25	4.28	3.9

It is clear from these experiments that the screw has a real power and that stopping it reduced the movement just 20 per cent. When the screw was removed, it will be noticed that the rate was on four occasions much slower than in any case in the two first series. This was no doubt owing to the wind blowing not only over but into, the open mouth and thus checking the up current. The effect of the screw therefore is twofold; it really aids the up current, and it lessens also the chances of the wind blowing down the tube.

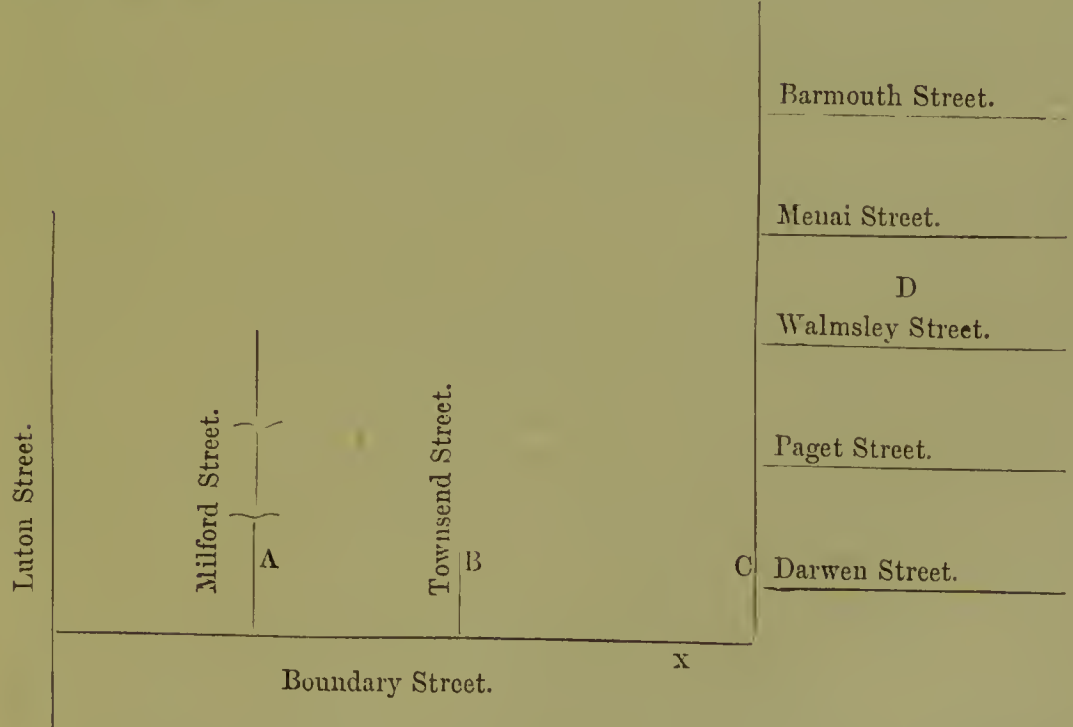
The height of the screw ventilator at the corner of Henry Edward and Fontenoy Streets was scarcely one-half of that in Townsend Street and the movement was considerably less, being in the former case 121, and in the latter case only 147 feet per minute, or at the rate of 1·37 and 1·67 miles per hour.

In all cases the section-area at the point where the anemometer was placed was 50 square inches (=·347 square foot). At the linear rate of 88 feet per minute or one mile per hour the discharge would be 1,832 cubic feet in an hour. The Townsend Street shaft therefore discharged per hour (1,832 × 5·25) 9,618 cubic feet, and this will represent we believe the most favorable result of the ventilators. On the plan of Townsend Street appended to the Report there appear to be about 7,000 linear feet of sewer with 4 ventilators. Supposing that the section-area of the sewers is 7 square feet, the total air contents of the sewers would be 49,000 cubic feet, so that the air would be changed once in

every 77 minutes by the action of the 4 ventilators. But this is doubtless placing the facts in far too favorable light for the ventilators, as one might be drawing against another : and the great height and position of the Townsend Street shaft renders it likely that we had chosen one of the most efficient outlets. It would have required simultaneous and numerous determinations of all the shafts to permit us to use this method of reasoning, and we prefer to put the facts in another way.

It appears that the ventilators regarded as mechanical contrivances are successful, *i.e.*, that the quantity of air which they discharge per hour is large as compared with their sectional area. But to judge of their practical utility we have to consider not the rate of movement in the ventilators themselves, but their efficiency in producing movement in the sewers with which they communicate. The most important points for inquiry are first whether the quantity of air discharged by them is sufficient for the required purpose, and secondly whether if it be admitted to be sufficient, the ventilators are so placed as to act in combination with each other or the contrary. It will be convenient to consider the second point first.

In illustration of the mutual action of the two existing ventilators on each other we may take as an example the system of sewers with reference to which the experiments above recorded were made. The sewer in Townsend Street, as shown in the accompanying diagram,—



N.B.—For a more accurate view of the relations of these sewers, see the Plan in the appendix.

is a tributary of the larger sewer in Boundary Street. Above Townsend Street the Boundary Street sewer receives branches from Menai Street, Walmsley Street, Paget Street, and Darwen Street. Below Townsend Street it receives two tributaries viz. : from the upper half of Milford Street and from Luton Street. Connected with the sewers mentioned there are 4 ventilators viz. : one in Milford Street, one in Townsend Street, one opposite Darwen Street, and one in a Court leading into Walmsley Street. As has been already noticed an air current usually exists in a sewer in the same direction as the stream. Granting this, it is easy to show that the effect of the ventilators placed as they are, would be on the whole unfavorable; for their draught would be opposed to that of the air current already existing, and would therefore tend to diminish it. In the case of there being no previously existing current, *i.e* .no movement of air due to accidental causes, the action of the ventilators would be equally unfavorable ; for if the ventilators A. B. C. D. act equally, it is clear that at all intermediate points they must neutralize each other's influence. Thus, for example, at the point (x) there must be stagnation, for whatever movement would otherwise be produced by A. and B. would be neutralized by C. and D. So also between A. and B. and between C. and D. respectively there must be points at which the effects are similarly balanced.

It is not however necessary to carry this kind of reasoning further, for even if the arrangement of the ventilators were most favorable, and their action perfect, their influence on the movement of air in the sewers must be so trifling as to be practically unworthy of consideration. The reason of this is that their size is out of proportion with the work they are supposed to perform. The internal diameter of each ventilator is under 8 inches. Hence if we assume that the available sectional area of most of the sewers is equal to that of a circle 3 feet in diameter, we have (the areas of two circles being to each other as the squares of their diameters) the sectional area of the sewer about 20 times as great as that of the ventilators. Consequently if we suppose such a ventilator to communicate with a sewer in which there would otherwise be no current, it would (theoretically) produce a current in either direction of one-fortieth of the velocity of its own current, so that if we assume the ascent of air in a ventilator to be at the rate of 10 miles an hour, an assumption which we need scarely say is extreme, the utmost resulting movement in the sewer of air towards the ventilator in either direction, would be a quarter of a mile per hour.*

* Since the above was written we have received the exact measurement of the sewer in Boundary Street. The sectional area is 18.15 square feet, consequently that of the ventilator being one-fifth of a square foot the former is 90 times as great as the latter. So that a movement of 10 miles per hour in the ventilator would produce a movement of only one-eighteenth of a mile in the sewer.

Practically the movement would be so small that excepting in the immediate neighbourhood of the outlet, it could not be measured by the most delicate instrument.

We now return to the practical recommendations which follow from these considerations, but as none of the suggestions relating to the management and ventilation of the sewers, which we desire to submit to you could be carried out without additional detailed information, we think it desirable that in the first instance the whole subject be referred to your own Officers and therefore propose to submit to you certain heads of inquiry which may serve as instructions for the preparation of a detailed report.

The subjects on which it appears to us necessary to obtain more complete information in order to efficient action are the following :—

(1) The state of the sewers as regards deposits.

(2) The arrangements which should be made for the safe discharge of the steam from Engine boilers.

(3) The mode of remedying the existing defect of water for flushing.

(4) The escape of sewer air into the streets and houses.

With reference to each of these headings we shall indicate the measures which we think most necessary, leaving the way in which they are to be carried out to be determined according to the advice of your own Officers.

1.—The first subject of inquiry should be the present state of the sewers as regards deposits of sewage, the depth and nature of such deposits, the causes to which, in the opinion of the Borough Engineer they are due, and the works which are necessary for their prevention and removal.

In all cases we recommend that these necessary works shall be immediately commenced.

The " list of sewers shewing the depth and extent of deposit " appended to this report will serve to indicate the direction in which this inquiry must be made.

2.—The second section of the proposed Report should relate to steam-engine boilers communicating with the public sewers, and the works which are necessary (if any) in order to provide for the safe discharge of their contents. For this purpose an inspection must be made under the direction of the Borough Engineer, of all manufactories in which steam engines are believed to be employed, for the purpose of ascertaining in what way the periodical emptying of the boilers is effected. In all cases in which the boilers are fixed at such a level that they cannot be emptied otherwise than with the aid of steam pressure, or in which, on other grounds, there is reason to believe that the contents of the boilers are discharged

in a temperature approaching the boiling point, into any sewer, we think that the owners of such boilers ought to be required to provide a tank or cooling reservoir for the reception of the hot water during the process, in which it could be retained long enough to allow of its becoming sufficiently cool, and that in all other cases in which there is reason to believe that the contents of the boilers are discharged at an improper temperature, the practice be put a stop to.

We are not aware to what extent the powers vested in the Corporation for the regulation of the sewers may be sufficient for the enforcement of these or other similar measures, but we regard the matter as of such serious moment that, if existing legislation is inadequate, efforts should be made for its amendment.

3.—Your Engineer has repeatedly in his able reports called attention to the deficiency of the existing water supply for the purposes of surface cleansing and sewer flushing. In his Report of 1848 he recommended a plan for the expeditious flushing of all the main sewers, and at the same time pointed out that in addition to this, the means should exist of "washing impurities from the surfaces of streets and courts. For this purpose every court should have a branch with a stand pipe at its upper end for the washing of it daily. Every street should also have stand pipes at such distances apart that its whole surface may be washed over with the aid of a short hose. From these stand pipes also the streets should be watered" (p. 97.) In his evidence before the mortality sub-committee he further stated:—"Some time ago the Water Engineer and myself contemplated the introduction of the Parisian system of Bornes-fontaines, which are somewhat like our stand pipes erected at intervals along the streets, courts, lanes and alleys. From these the water is allowed to run freely along the channels for a certain time every day and wash away all impurities." But adds Mr. Newlands "our water supply has never been in a condition to admit of this." "The deficient water supply has thrown us back after 18 years to much the same condition in which we were in 1848, with the difference of extended works, and increased wants."

With all that Mr. Newlands has said as to the necessity of increased supply of water, we entirely agree and believe that it would be of the greatest advantage to the town of Liverpool if such a plan of surface irrigation as has been so repeatedly recommended by him could be carried out.

It is clear from the evidence, that the only obstacle which stands in the way of this desirable result is the want of water. It appears to us that this difficulty might be partly met by utilizing for the purpose the condensation-water from the manufactories. According to the statements which have been made

to us the discharge of such water, amounts to nearly 4 Million Gallons daily from only a portion of the manufactories. The whole of this enormous quantity is pumped every day to the surface by steam engines and is at present in great measure wasted, being discharged by each manufacturer into whatever sewer happens to receive the drainage of his works. This water is for the most part perfectly clean and fit in every respect for the purpose of surface cleansing. That there are no serious Engineering difficulties in the way of its being made available for irrigation in all the lower parts of the town, *i.e.*, wherever there happens to be a discharge at a higher level than that at the surface, we think admits of no question, nor do we think it probable that the Corporation would find any difficulty in arranging with the manufacturers for the disposal of a commodity which is so entirely of the nature of a waste product.

There are two considerations which encourage us in earnestly recommending this proposal to the attention of the Corporation. The first is the one we have already dwelt upon,—the expediency of obtaining a more abundant supply of water for surface as well as for sewer flushing. The second which is not so obvious is perhaps no less important. We refer to the unknown danger arising from mixing with sewage, water at the temperature which is known to be most favorable to putrefactive change. We cannot take upon ourselves to say how great that danger may be, for there are no data on which it can be estimated. In any case the scheme we submit, seems to us to offer a way of escaping from it, as well as from all the other inconveniences which arise from the practice in question, while it retains all the good arising from this water entering the sewer.

On this subject it will be necessary that you should have a full report from your Engineer, as to the accuracy of the statements we have referred to regarding the quantity of water available,—as to the sewers into which it is at present discharged, and as to the constructive works which would be required in order to make it available for the purpose.

4.—In the fourth section it should be shewn in what localities, sewer-air habitually escapes from the outlets into the streets and houses in such quantities as to be offensive; to what circumstances such escape is attributable, and what measures ought to be adopted for the remedy of the evil. From observation we are led to believe that offensive discharges of sewer-air are mostly to be attributed to deposits in the sewers, and that if a sewer is properly constructed and has a sufficient inclination and a sufficient flow of water, the air escaping from it will not be seriously objectionable. We are however well aware that there are some cases in which, in consequence of accidental peculiarities of construction, discharges of sewer-air may constitute a nuisance notwithstanding

that the sewers themselves are in good order. In all cases in which there are offensive discharges, we think that the expediency of adopting special measures of ventilation ought to be discussed. But before any such measures are actually taken, careful observations should always be made extending over a sufficient period for the purpose of ascertaining :

(1) Whether the supposed escape is frequent or merely accidental, and

(2) Whether it is of such a nature as to be capable of remedy by ventilation.

As means of ventilation we recommend the erection of large vertical shafts, the sectional area of which must be at least half as great as that of the sewers. The form and construction of these shafts must be determined by special circumstances. We content ourselves with observing that they should be as high as possible and that in every case their apertures should be at a sufficient distance from houses.*

We believe that, when the matter is investigated by the Engineer, the cases in which these special appliances for ventilation are required will be found not to be numerous, and on this account we recommend that whatever sum of money is destined for the purpose should be rather expended in erecting large and efficient shafts where they are urgently needed, than in the construction of a multitude of ventilators similar in size to those which at present exist.

We would not propose however to alter the shafts which at present exist, but simply to supplement them at certain points by others which we believe will be more efficient.

We think it desirable to sum up our recommendations on the question of the sewerage in a few sentences.

1.—We recommend that a complete and exhaustive inquiry be made as to the existence of deposits in the sewers, and that in all cases in which such deposits are in the opinion of the Borough Engineer dependent on defective construction, defective inclination or insufficient supply of water, the works necessary for the remedy of these defects be immediately commenced.

2.—In those cases in which the foul condition of the sewers appears to be unavoidable, *e.g.* in those sewers which are affected by the tide, we recommend ventilation. For this purpose we think that spacious and lofty shafts, afford the only effective means.

3.—We advise that in courts and in streets adjacent to them, there shall be no inlets to the drains within the houses.

---

* The employment of charcoal trays in these shafts may be a matter for after consideration.

4.—We do not recommend the adoption of any general system of ventilation, as we believe that the measures we have indicated will accomplish all that is necessary.

5.—We recommend that a complete report be made as to the quantity of waste water discharged into the sewers by manufacturers with a view first to the prevention of its introduction into the sewers in a warm state; and, secondly, to its being if possible utilized for surface cleansing and sewer flushing.

In concluding this section of our Report, we beg to express our conviction hat it is not desirable to make any change in the present system of removing excreta. We do not wish to express any abstract opinion as to the respective merits of the water or dry method of removing fœcal matter, but looking to the circumstances under which Liverpool is placed we have no difficulty in coming to the conviction above stated for these reasons.

1.—Liverpool is well provided with sewers, many of which have been constructed with great care and cost.

2.—Structural defects or imperfection in action, in certain cases, can we believe be remedied.

3.—There is less difficulty than in many towns, in getting rid of the sewage.

4.—No other plan if now introduced could prevent the use of water-closets in a large portion of the town, and consequently excreta could not be kept out of the sewers.

5.—As no complete plan of dealing with the sewage of towns as large as Liverpool, has passed beyond the stage of experiment except the water sewerage system, we could not advise the Corporation to abandon or even modify a system in full operation, in unison with the habits of the majority of the population, and for which no substitute whose success could be guaranteed, can be pointed out.

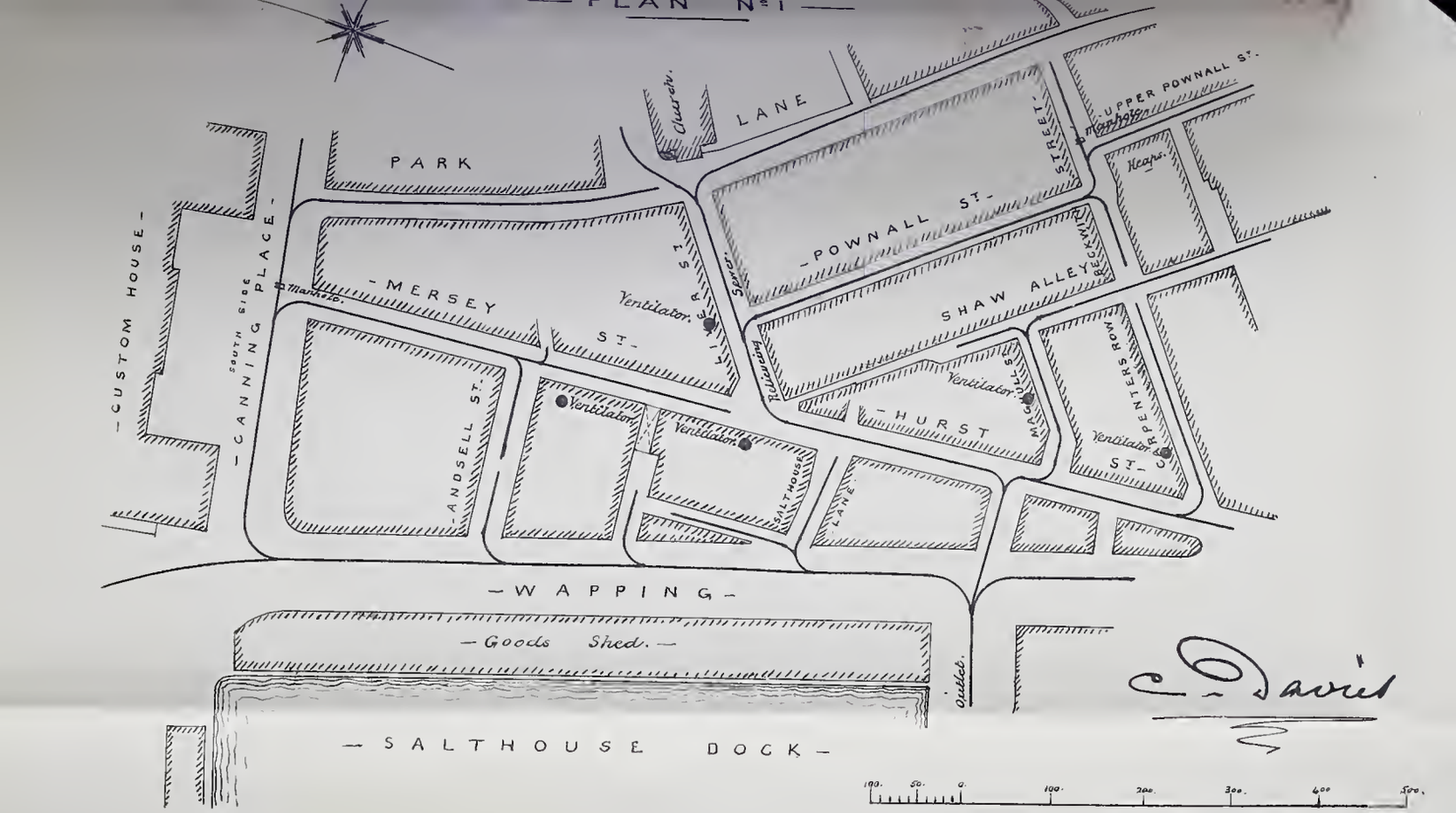
It would be useless for us to enter into an argument against a return to the barbarous system of middens, and needless to point out the difficulties of transport and disposal, which hamper all plans which aim at the daily removal of the excreta of great cities, otherwise than by water carriage. For even if such difficulties were overcome and if the excreta were removed as expeditiously as by the water method, which is impossible, a plan would be of little use unless it could be applied to the town as a whole.

On this point we believe the time for argument has gone by; the system of water sewerage has been so thoroughly established in Liverpool, that it cannot

be given up, and the proper policy is to recognize this fact and to act on it by making the sewers as perfect as possible. No one can read Mr. Newlands' Reports and study his suggestions without seeing that he could soon have removed all possible causes of dissatisfaction, and we believe if all Mr. Newlands' plans had been carried there would have been no necessity for the improvements we have suggested.

E. A. PARKES, M.D., F.R.S.

J. BURDON-SANDERSON, M.D., F.R.S.

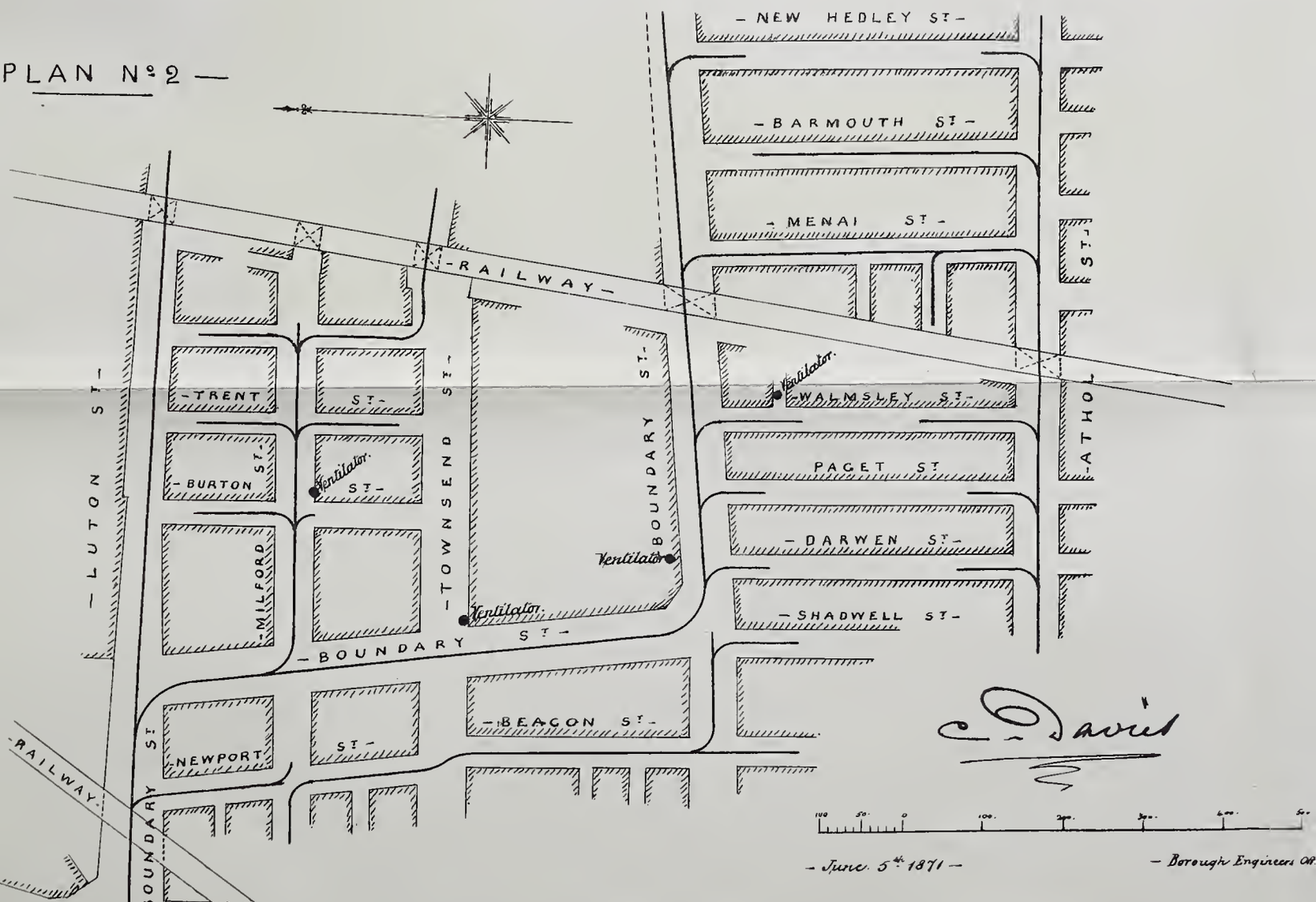


C. Davies

June, 5th 1871

Borough Engineers Office.

PLAN No 2



C. Davies

June 5th 1871

Borough Engineers Office

APPENDIX.

CONTENTS.

DESCRIPTION OF TRACINGS.

1.—A tracing of Canning Place Sewer showing that the System of Drainage formed by that Sewer into its two tributaries does not communicate with any other. In such a Sewer the supposed effect of the tide in driving the air upwards from the outlets towards the inlets would be much greater than in a system of greater extent. On the same street is shown the course of the Pownall Street Sewer, into which water and air are discharged from the works of Messrs. Heap & Co.

2.—Plan of the Boundary Street Sewer showing the osition of the Ventilators.

LIST OF SEWERS

SHOWING EXTENT AND DEPTH OF DEPOSIT.

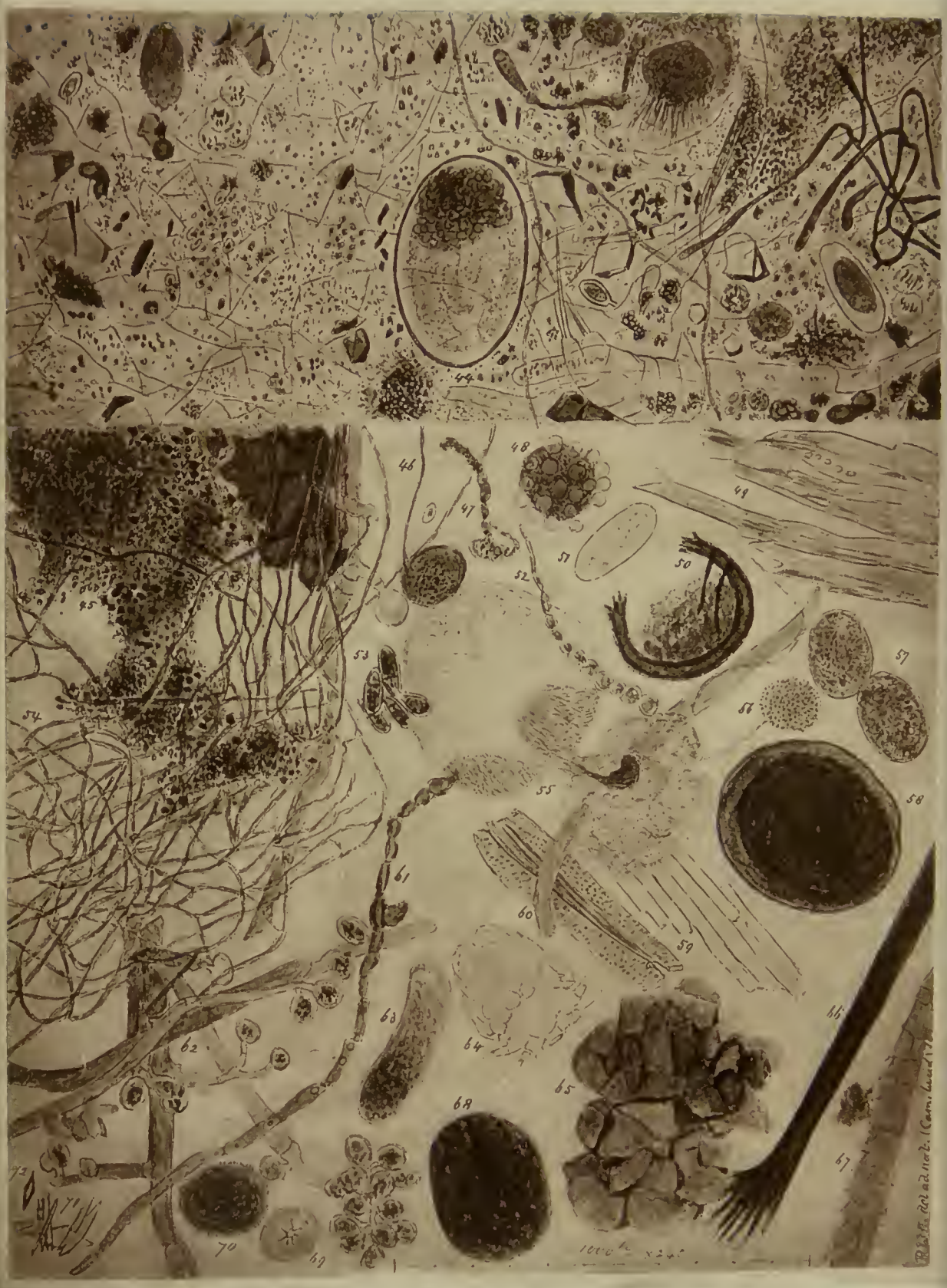
Names of Streets.	Length in Yards.	Depth of Silt in Inches.	Remarks.
Charters Street,	200	6	Old Sewer very flat.
Edgar ,,	112	2	
Cherry Lane,	215	2	
Back Chisenhale Street,	100	7	Old Sewer very flat.
Collingwood ,,	140	4	Very flat in hollow of Street.
Hodgson ,,	146	9	Old Sewer ,, ,,
Leeds ,,	350	6	
Midghall ,,	195	4	
Addison ,,	110	4	
Clement ,,	213	3	
Bow ,,	72	8	
Down ,,	132	4	
Nash Grove,	181	3	
Vauxhall Road,	500	6	Old Sewer very little fall.
Birkett Street,	107	4	
Dublin ,,	205	6	
Oriel ,,	207	6	
St. Martin ,,	125	5	
Harrison ,,	82	3	
Back Milton ,,	76	5	
Maguire ,,	198	1	
Ryley's Gardens,	55	8	
Duckenfield Street,	201	4	
St. Andrew ,,	233	3	
Troubridge ,,	190	7	
Manesty Lane,	229	12	All under High Water with very little fall.
Argyle Street,	140	4	

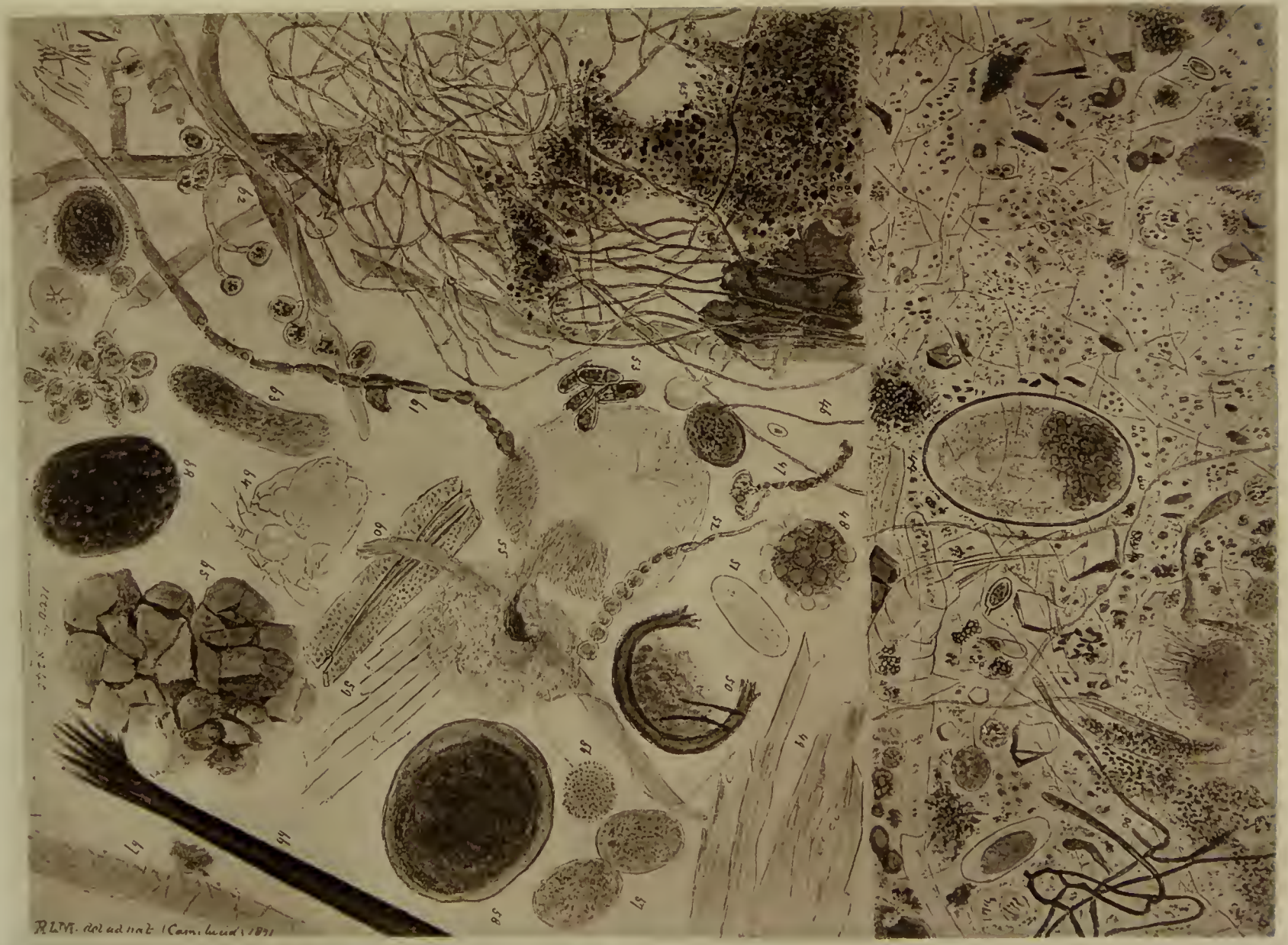
Names of Streets.	Length in Yards.	Depth of Silt in Inches.	Remarks.
Price Street,	72	6	
Frederiek Street,	135	5	
Cleveland Square,	30	4	
Park Lane,	50	6	
Canning Plaee,	600	7	
Mersey Street,	189	8	
Queen's Doek, East Side,	319	4	
Cooper's Row,	91	5	
Redcross Street,	50	4	
Carpenter's Row,	87	5	All under High Water with very little fall.
King Street,	72	7	
College Lane,	120	6	
Atherton Street,	152	5	
Finney Lane,	34	8	
Cable Street,	55	5	
Paradise ,,	351	8	
Whitechapel,	455	5	
Churcli Lane,	88	4	
Williamson Street,	144	2	
Mann ,,	150	6	
Hyslop ,,	205	3	
Clive ,,	116	4	
Southwell ,,	55	3	
Jaekson ,,	91	3	
Head ,,	181	3	
Low Wood ,,	238	3	
Oliver ,,	232	3	
Holden ,,	191	3	
Riehmond Row,	40	9	Old Sewer very little fall at Byrom Street.

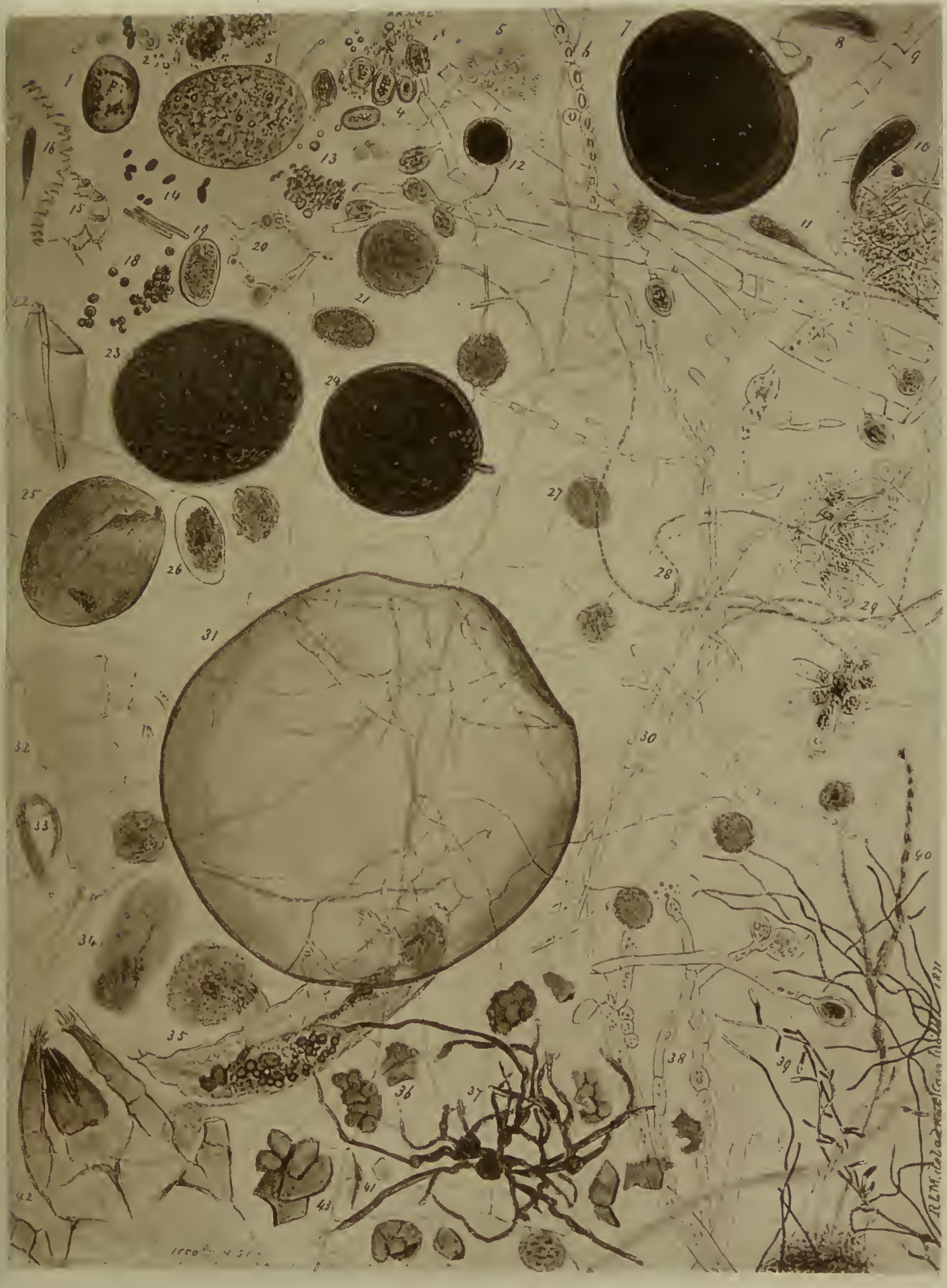
Fontenoy Street, at the corner of Henry Edward Street :—

Sectional area of Sewer, old Sewer	7,069	supl. feet.
Ditto ditto new Sewer	4,970	,,
In Court No. 1, Hodgson Street	0,442	,,
Braneh at Townsend Street	5,151	,,

NOTE.—This braneh is eonneeted with the Beacons Gutter or Boundary Street outlet, the sectional area of which is 18,154 superfieial feet.


44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72





APPENDIX.

Note on the "Sewer Slime" obtained from the roof of the sewer in Richmond Row.

We give in an appendix two photographs of drawings of the objects found in the "sewer slime" which was taken from the crown of the sewer in Richmond Row. We have also given a few chemical points connected with this slime. These observations are of no immediate practical use, that is to say we are unable at present to connect any disease with the special growths in the sewer slime, but as there is a possibility that the progress of inquiry may give significance to some of these objects we have attached the drawings.

The sewer slime is a jelly-like substance composed of a mixture of dark coloured and greyish material. It is very alkaline from ammonia and contains nitrates. In the sample from Liverpool the ammonia obtained by distilation with caustic soda amounted to ·0025 per cent.; the so-termed "albuminoid ammonia" determined by Wanklyn's method was ·00462 per cent. and the amount of nitric acid was ·235 per cent. Offensive volatile substances were given off.

On microscopic examination it was found to consist of an immense amount of fungoid growth mixed with different kinds of animal life. The annexed photographs of drawings made by Dr. Maddox may be of interest in showing what is contained in the sewer slime; it has not been possible to name all the objects, but they have been all numbered for the purpose of future identification. For this we have also to thank Dr. Maddox. The figures were magnified 240 diameters, but the size of the plates has been reduced in photographing from 8 × 6 to $6\frac{1}{4}$ to $4\frac{3}{4}$ inches.

Fig. 1.—Sporangium of some mucor in a state of decay. Several were noticed paler and filled with yellowish granular matter.

,, 2.—Free spores numerous;—the dark oval ones possibly some form of smut.

,, 3.—Large pale sporange.

,, 4.—Mycelium with spores attached found abundantly in the pale or less discoloured part the of jelly mass. Mucor Racemosus (?)

,, 5.—Small pale mucoid masses unattached to any mycelium containing minute yellowish bacteroid bodies. Gonidial elements of one of the fungi.

Fig. 6.—Terminal portion of a mycelial filament.

,, 7.—Large dark sporangium (rare in this stage) taken from the stem of the mycelium (one of the Nidulariaca or Peresporacei).

,, 8.—Some form of spore ruptured from the bearing filament—perhaps some ascigerous stage of mucor.

,, 9.—Filament with circular terminal spore of mucor racemosus ?

,, 10.—Same as figure 8, but in a stage of decay.

,, 11.—Same seen attached to the mycelial filament.

,, 12.—Spore vesicle of mucor.

,, 13.—Small mass of minute spores ; very abundant.

,, 14.—Dark olive coloured oval spores ; some form of smut.

,, 15.—Leg of Acarus.

,, 16.—Vegetable spiral fibre, common, simple and double, found in considerable lengths.

,, 17.—Scale of gnat.

,, 18.—Globose olive coloured spores of ?

,, 19.—Ovum of ?

,, 20.—A young plant developed from a spore similar to those at the right of figure 13.

,, 21.—Two vesicles, or heads of some mucor, proceeding to the development of spores.

,, 22.—Egg case of some small insect, common.

,, 23.—One stage in the sporangium of figure 7, the granular mass undergoing segmentation.

, 24.—Another stage of figure 7 or 23.

,, 25.—Yellow ovum, ruptured ; empty shell.

,, 26.—Ovum, supposed to be the same as figure 19.

,, 27.—Numerous faded heads of some mucor, attached to *very fine* mycelial filaments, very abundant in the slime.

,, 28.—A young plant of ?

,, 29.—Two stems with attached spores divided by a septum below the middle. Arthrobotrys ? one of the mucidines ? very doubtful, rare.

Fig. 30.—Pale mycelial filaments, very abundant, but without any form of sporange found developed.

,, 31.—Nid of small spider ?

,, 32.—Part of the body of a small Entomostraca—Canthocamptus minutus.—

,, 33.—A small Anguillula, many seen in the slime, but generally much decayed.

,, 34.—Ovum of ?

,, 35.—A Tardigrade, Macrobistus Huflandii ?

,, 36.—Small irregularly crystalline masses of carbonate of lime.

,, 37.—Dark coloured filaments of mildew.

,, 38.—Filaments of mucor racemosus (?) one discharging minute bodies from the end vesicle by pressure.

,, 39.—A minute form of some conferva ; (the same has been met with a day or two since with other conferva from a fresh water pond, only having the endochrome of a bright green colour).

,, 40.—Mildew attached to the mass of dark grumous granular matter so abundant in the slime.

,, 41.—A minute crystal octohedron showing colours distinctly, rare.

,, 42.—Part of the body of an Acarus, very abundant in all stages of development.

,, 43.—A very long and delicate mycelium, constant in the portions examined.

,, 44.—The central fig : An ovum with the embryo partly developed. The whole fig. gives the ordinary appearance under the microscope of the light coloured part of the slime and contains some of the bodies figured separately, minute bacteroid bodies abounded, but none were noticed in movement.

,, 45.—The general appearance of the dark part of the slime containing numerous small circular spores like fig. 13, and small dark irregular masses mixed with them.

,, 46.—A single filament of (?) with vesicle or peridiole attached.

,, 47.—A microscopic fungus supposed to be developed from a spore similar to the one to the left of the figure.

,, 48.—Peridiole of a mucor with unripe spores.

Fig. 49.—Fragments of vegetable tissue, common.

,, 50.—One of the chitinous segments near the thorax of a larva of a dipterous insect.

,, 51.—Ovum of? Tardigrade?

,. 52.—A young mildew.

,, 53.—Separated spores of arthrobotrys?

,, 54.—Pale grey mycelial filaments very abundant in the dark portions of the slime, some of a much darker tint.

,, 55.—Doubtful? An arachidon in one stage of development? (it has also somewhat the appearance of an entozoon).

,, 56.—Peridiole of a mildew covered with small spinous processes.

,, 57.—Two sporangia, supposed similar to fig. 3.

,, 58.—One stage in the development of the sporangium of fig. 8.

,, 59.—Simple and dotted vegetable tissue, abundant; the latter often in much larger pieces.

,, 60.—A small hematoid worm.

,, 61.—A mildew.

,, 62.—Dark grey filaments of mucor found chiefly in the discoloured portions of the slime due to the fœtid gases evolved by decomposition.

,, 63.—Supposed to be an ovum of?

,, 64.—Supposed early stage of some minute marine crustacea.

,, 65.—Small mass of irregularly crystalized carbonate of lime, many of the masses were more than quadruple this size.

,, 66.—Woody fibre.

,, 67.—Animal hair, wool fibre.

,, 68.—Sporangium filled with fine greenish granular matter.

,, 69.—Starch grain.

,, 70.—Supposed to be one stage of development of the peridiole of fig. 7

,, 71.—Curved attached somewhat acicular crystals.

,, 72.—Some octohedron crystalline form as in fig. 41 but colours much less brilliant. (The want of colour in the photographs is a disadvantage towards recognizing the various objects.)

At a Meeting of the Council of the Borough of Liverpool, holden on Wednesday, 9th day of August, 1871,

PRESENT :

JOSEPH GIBBONS LIVINGSTON, ESQ., MAYOR,

AND A FULL COUNCIL.

Read letter from Dr. Parkes and Dr. Sanderson, dated 3rd August, 1871, enclosing the second portion of their Report on the Sanitary condition of Liverpool.

Resolved—

That the same be referred to the Health Committee and printed, and a copy sent to each Member of the Council.

EXTRACTED FROM THE PROCEEDINGS,

JOSEPH RAYNER,

TOWN CLERK.

Bitterne,

Southampton, 3rd August, 1871.

Joseph Rayner, Esq.,

Town Clerk of Liverpool.

Sir,

We have now the honour to forward to you the second and concluding part of our Report on the Health of Liverpool.

In ending this Report, we feel it our duty to ask you to convey to the Worshipful the Mayor our best thanks for the very great support and assistance he afforded us.

We have also to thank most cordially Dr. Trench, Dr. Taylor, Mr. Evans, Mr. Reynolds, and all the other Municipal Officers, who all seemed actuated by an earnest desire to aid us in our enquiry.

We shall be happy, indeed, if the enquiry contributes in any degree to an improvement in the health of the inhabitants of your great city.

We have the honour to be, Sir,

Your most obedient Servants,

E. A. PARKES, M.D.

J. BURDON SANDERSON, M.D.

REPORT ON THE SANITARY CONDITION OF LIVERPOOL, BY E. A. PARKES, M.D., F.R.S., AND J. BURDON SANDERSON, M.D., F.R.S.

PART II.

In this section of our Report, we proceed to enquire into the causes of the high mortality which has existed for so many years in Liverpool. On this subject, we have found much information in the works of Dr. Duncan and Dr. Trench, and others, and in the instructive evidence given before the Mortality Sub-Committee of 1865. But we have endeavoured to work out the question for ourselves, and for this purpose obtained from the Registrar-General* permission to make use of the Statistical Returns in the Office in London.

From these Returns, and from those taken from Dr. Trench's Annual Reports, we proceed to state—

1. The mortality of Liverpool as compared with other large towns.

2. The comparative mortality of districts in Liverpool itself.

3. The comparative mortality of certain streets in Liverpool.

4. The sanitary condition of those streets, and, by inference, of others like them.

In conclusion, we will state the practical recommendations to which our examination has led us.

I. Comparison of Liverpool with other large Cities.

Years.	Annual Mortality per 1000 living. Liverpool Registration District.†
1861	32·4
1862	33·7

* We must express our thanks to the Registrar General for this permission, and to Dr. Farr and other Officers of the establishment for their kindness and assistance.

† The Registration district is the parish of Liverpool, and not the borough, and includes the sub-registration districts of St. Martin's, Great Howard, Dale-street, Islington, St. George, St. Thomas, and Mount Pleasant. The calculation is made on the mean annual population as determined by the Census of 1861 and 1871.

Years.	Annual Mortality per 1000 living. Liv rpool Registration District.
1863	37·6
1864	41·7
1865	*44 0
1866	†50·7
1867	35·4
1868	35·3
1869	36·3
1870	38·8
Mean of 10 years	38.59

In the same ten years, the mean annual mortality per 1,000 of population, calculated upon the mean annual population of 1861–1871, was as follows in the undermentioned towns.

Bristol	22·5
London	24·3
Hull	24·9
Bradford	26·2
Sheffield	27·2
Leeds	28.0
Manchester	30·2

Liverpool has a far higher average mortality than these seven large seaport or manufacturing towns. It is well known also to have constantly a very great excess of mortality as compared with Birkenhead.‡

The mortality in Liverpool may be divided into two categories—ordinary and extraordinary. The ordinary annual mortality in years not marked by any great epidemic disease is about 35 per 1,000 of population.§ In the years with epidemic outbreaks of Typhus, Cholera, or diseases of that class, it may amount even to 50 per 1,000, or 1 in every 20 of the population. This division, into normal and specially unhealthy years, is common to all towns, and affords a natural division of the inquiry into the causes of mortality.

To take the latter first. When epidemic diseases prevail frequently in a town, and cause in certain years an excessive mortality, they arise from two chief causes; 1st, the ready and frequent introduction of the cause of the

* Typhus Epidemic. In some other years also Typhus prevailed.

† Cholera Epidemic, Typhus and Diarrhœa.

‡ Dr. Baylis has been kind enough to give us the annual mortality per 1,000 in the Townships of Birkenhead and Claughton. It is as follows:—

YEARS.	ANNUAL MORTALITY PER 1.000.
1866	22·53
1867	20·84
1868	21·05
1869	19·76
1870	19·00
Mean of 5 years	20·64

Therefore in non-epidemic years the mortality of Liverpool is to that of Birkenhead as 7 to 4.

§ For this mean we have taken the six years, 1861, 1862, 1863, 1867, 1868, and 1869.

disease into the town; and 2nd, local conditions which always foster it or which allow its spread when introduced.* Both these causes exist in a high degree in Liverpool. Its position as the great seaport of the kingdom, for emigration, as well as for commerce generally, renders the arrival and departure of persons more frequent than in any other town of its size, and consequently increases greatly the chances of the introduction of any epidemic disease capable of being carried and imported, either from the continent of Europe or from Ireland. The introduction of Typhus, Cholera, Smallpox, or Relapsing Fever is therefore almost certain, if these diseases prevail in places with which it is in frequent communication.

It is not possible to alter this without surrendering the commercial supremacy of Liverpool, but some precautionary measures may be taken. Arrangements for the proper and healthy accommodation of emigrants, both Continental and Irish, so as to separate them completely from the permanent population, by locating them only in a certain district, would afford the best chance of stamping out or limiting the spread of an epidemic disease brought with them; and although it might not be possible to do this in the case of Irish, or othe labourers, who enter Liverpool in search of work,† still, even here precautions might be taken, whenever it is known that epidemic diseases are prevailing in the localities whence they come. As it is of such importance to Liverpool to receive early intimation of any epidemic disease prevailing in Germany and the North of Europe, or in Ireland, we suggest that arrangements should be made to obtain regular monthly Reports of the health of those countries as regards epidemic diseases, so as to be prepared for any contingency of the kind. But the local causes which aid the spread of these diseases (and which are all important as being removable) exist also in Liverpool to an unusual extent, as we shall show in a subsequent part of our Report.

Passing from the unusual to the ordinary mortality, we have to enquire why Liverpool should in this respect be less favourably placed than Bristol, London, or Hull.

II. Mortality of Districts.

In the following table, taken from Dr. Trench's Annual Reports, we give the mortality per 1,000 in the inhabitants of the districts after correction has been made for the deaths of persons contracting the diseases in the district, but dying in public institutions situate in other parts of the town.

* There may be general atmospheric conditions in addition to the two noted above; but if so, they have not been yet recognized with sufficient scientific precision to render it desirable to discuss them in this place.

† In 1868, as many as 5,000 vagrants entered the vagrant sheds of Liverpool in one week; and, in the summer months especially, this immense movement is paralleled every year.

Districts.	Years.					
	1865	1866	1867	1868	1869	1870
Scotland	38·6	43·4	26·8	28·2	27·9	29·1
Vauxhall	49·0	62·0	35·3	33·2	38·8	43·9
St. Paul's and Exchange	48·2	46·7	33·7	34·5	31·9	36·2
St. Anne's and Lime Street	45·5	47·9	33·3	31·6	34·3	36·3
Castle Street and St. Peter's	26·5	27·4	20·2	17·7	18·9	18·1
Pitt and Great George	32·0	43·4	29·4	31·3	29·3	34·6
Rodney and Abercromby	23·7	26·1	21·5	20·0	20·6	21·9
Everton and Kirkdale	29·5	32·6	24·9	26·7	26·6	26·4
West Derby	24·6	29·0	25·1	23·2	22·1	24·4
The Toxteths	32·2	37·5	24·5	27·7	27·6	33·0

These returns show at once that the ordinary high mortality of Liverpool is not distributed over the whole town. There are districts, such as the Rodney and Abercromby, Castle Street, and St. Peter's Wards, where the mortality may compare favourably with any town in England; while, in other districts, as in Vauxhall Ward, and St. Paul's and Exchange, a mortality, always excessive, reaches sometimes a most alarming height. This table at once does away with any question of an insalubrious climate being the cause of the high mortality in Liverpool. The difference must be connected, not with general conditions of climate, but with locality, and, if so, must arise either from conditions of soil, local sanitary faults, modes of living, or from occupations and personal habits.

III. Mortality of Streets.

To carry this statistical analysis farther, it is best to deal with limited areas. We have, therefore, selected certain streets which appeared to us to fairly represent those inhabited by the poorer classes in Liverpool. In addition to the information gained by personal inspection, statistical returns were procured of the population of these streets, and of the mortality during the last four years.

The tables are founded on data obtained from the Registrar's returns in London, and on lists of deaths obtained from the public Institutions in Liverpool, by means of which we have been enabled to refer back to the streets the deaths of residents occurring in the hospitals or infirmary. If any error exists in these tables, it must arise from some of the deaths in public

institutions not being properly traced to the streets, and the effect of this would be to make the mortality of these streets less than it should be. We do not think the error is great, and if it exists at all, it only strengthens the argument based on these tables.

For the purpose of a standard of comparison, we selected two healthy streets after consultation with some of the medical men of Liverpool, viz., Rodney and Egerton Streets. Rodney Street is mainly inhabited by a very respectable middle class; the number of children is small, and the average age of the population high. Egerton Street is inhabited by a class of skilled artizans getting good wages, clerks, custom-house officers, and other respectable persons. The other selected streets are inhabited by the lower class of labourers.

We have taken the mortality for the four years, 1867–70. As in the year 1866, there was an epidemic of Cholera, we have not included it, as we desired to see the results of the operation of the ordinary causes of mortality. And we have used the Census returns of 1871; for as there has been no alteration in building in these streets, we believe the population of 1871 represents as closely as possible the population of the four previous years.

TABLE

SHOWING THE TOTAL MORTALITY OF BOTH SEXES, AND OF ALL AGES, IN CERTAIN STREETS.

Street.	Character of Inhabitants.	Total Population Census of 1871.	Deaths from all causes in 4 years. 1867–70.	Mortality per 1000 per annum, calculated on the Census of 1871, all ages.
Rodney	Respectable First and Second Class Houses inhabited by well to do persons.	607	26	10·71
Egerton	Clerks, Custom House Officers, and Skilled Artizans.	357	38	26·61
Henry Edward	Poor Population, Artizans, Dock Labourers, &c., &c.	677	81	29·91
Adlington	..	936	120	32·10
Bispham	..	716	92	32·12
Lace	..	715	102	35·70
Addison	..	688	125	45·40
Sawney Pope.....	..	1016	227	55·86

It appears from this table that Rodney Street is remarkably healthy, and would probably contrast favourably with any village in the country of 600 inhabitants. Egerton Street has a mortality which is considerably below that of the town in general (as 26 to 35), though still its deaths are higher than they should be. The death-rate increases gradually in the other streets on the list, until in Addison and Sawney Pope Streets it reaches the enormous amount of 45·4 and 55·86 deaths per 1000 per annum. From this table it perhaps may be inferred that the large ordinary mortality of Liverpool must be owing chiefly to the great number of streets, which, like Lace and Bispham Streets, have a high though not excessive death-rate, but in part also to the excessive mortality of certain streets like Addison and Sawney Pope Streets.

The idea that there is something unhealthy in the climate of Liverpool is again sufficiently disposed of by the fact that a street like Rodney Street, well elevated, wide and airy, and inhabited by a respectable class, presents a degree of healthiness to which it might be difficult to find many parallels in the most healthy towns.

We proceed to analyse the table, and first must apportion the mortality to age.

TABLE

TO SHEW THE MORTALITY TO POPULATION UNDER ONE YEAR, AND UNDER FIVE YEARS OF AGE.

Street.	Persons living under 1 year of age at the Census of 1871.	Deaths of persons under 1 year of age in 4 years, (1867–70.)	Annual mortality per 1000 of the population under 1 year of age.	Persons living under 5 years of age at the Census of 1871.	Deaths in 4 years under 5 years of age, (1867–70.)	Annual mortality per 1000 of the population under 5 years of age.	Percentage of deaths under 5 years to total deaths at all ages.
Rodney	5	1	·50	26	4	38·46	15·38
Egerton	13	12	230·7	40	17	106·25	44·7
Henry Edward	20	17	212·5	83	38	114·5	46·9
Adlington	26	31	298·1	112	57	127·2	47·5
Bispham.....	21	22	261·9	100	56	140·0	60·87
Lace	9	21	583·3	61	40	163.9	39·2
Addison	19	18	236·8	89	45	126·4	36·0
Sawney Pope.....	32	51	398·4	102	106	259·8	46·67
Healthy districts in England (Farr) ..	..	..	..	..	..	40·36	..

From this table it appears that out of 100 children under one year of age, only 5 die annually in Rodney Street; 58 die in Lace Street; 40 in Sawney Pope Street; 30 in Adlington Street; and from 21 to 26 in the other streets; Egerton Street in this respect, is even worse than Henry Edward Street.

If, however, as giving a safer guide, we take the mortality among 100 children under five years of age, there die annually (in round numbers)

In	Rodney Street	4 Children.
„	Egerton Street	10½ „
„	Henry Edward Street	11½ „
„	Addison Street	12½ „
„	Adlington Street	13 „
„	Bispham Street	14 „
„	Lace Street	16 „
„	Sawney Pope Street..	26 „

This table brings out clearly the enormous death-rate of children; it would hardly be credited that even the advantages of Rodney Street, in point of situation and of class of people, would make a difference so great.

It seems a frightful circumstance that in the same town there should be a contrast so appalling as that between Rodney Street and Sawney Pope Street. Even Egerton Street, though inhabited by so respectable a class of people, does not in this respect stand so well as it should do.

This table proves also, from the last column, that the great mortality in the poor streets arises partly from the loss of life of children under five years of age. In Sawney Pope Street it may be said that of every two deaths, one is of a child under five years of age, and in Bispham Street, the proportion is even higher, and is not very far from giving two deaths of children to one of persons over five years of age.

That this is not simply a condition belonging only to these streets, but extends over a large part of the town, is shown by the following table, taken from Dr. Trench's able Annual Reports.

TABLE.

Wards.	Per centage of Deaths of Persons under 5 Years of Age to total Deaths.		
	Years.		
	1868.	1869.	1870.
Scotland	62·4	60·5	62·9
Vauxhall	60·1	60·0	56·1
St. Paul's	55·1	52·6	51·1
Exchange	52·1	49·1	46·0
St. Anne's	61·0	59·0	54·9
Lime Street	50·8	41·6	51·3
Castle Street	32·3	42·6	41·3
St. Peter's	46·3	44·1	42·4
Pitt Street	49·3	47·1	53·7
Great George	53·2	48·2	54·4
Rodney	44·3	42·4	47·1
Abercromby	44·3	42·4	47·2

So that the numbers in some of the selected streets are even below the amounts in the districts, proving both that there are streets still worse than those selected, and that the bad streets must be extremely numerous.

It may be interesting to compare these numbers with those of some good and bad streets in London. In Dr. Buchanan's Reports of the mortality of some of the worst streets in St. Giles (viz., Church Lane, Dudley Street, and Short's Gardens), as compared with the fine open adjacent squares of Russell and Bedford, we find the following numbers.*

TABLE

TO SHOW MORTALITY IN SOME LONDON STREETS.

Place.	1861. Annual mortality per 1000 of population, all ages.			1862. Annual mortality per 1000 of population.			1863. Annual mortality per 1000 of population.		
	Total.	Under 5 years.	Percentage of deaths under 5 years to total deaths.	Total.	Under 5 yrs.	Per-eent.	Total.	Under 5 yrs.	Per-eent.
Bedford Square	12·9	3.3	26·6	17	6·1	37·9	16·2	6.1	37·6
Russell Square	14·2	3·9	27·4	13·5	4·0	29·6	12 9	2.7	16·0
Church Lane, St. Giles	30·6	16·5	54·0	34·2	16·6	48·6	30·1	13·4	44·6
Dudley Street, St. Giles	32·4	16·2	50·0	31·1	15·9	51·2	30·9	17·2	55·5
Short's Gardens, St. Giles	34·7	16·6	47·9	39·1	15·4	39.4	37·7	17·8	47·3

On comparing this table with those of the Liverpool streets, it appears that there are streets in Liverpool as healthy as these fine squares in London, and that there are streets in St. Giles in London which have a mortality equal to many of the Liverpool streets, though certainly even St. Giles' does not approach the great mortality of Addison and Sawney Pope Streets.

The mortality of children under five years in St. Giles', assumes, however, relative proportions as great as in Liverpool, and doubtless owns the same causes. But what makes the great difference between the two cities, is that in Liverpool there is a large relative proportion of streets with high mortality,† while in London, the mean mortality of the whole city is reduced by the preponderance of healthy streets and districts.

The effect of the excessive infant mortality of Liverpool is to reduce the average age at death. That is, if the total years at death of all who die are

* We have not been able to put the table in precisely the same form as that of the Liverpool streets, as we do not know the number of the population at the different ages, but the table as it is tells its own tale.

† According to Dr. Trench's estimate, founded on the statistics of registered houses, the proportion of the Liverpool population now inhabiting houses of the same class as our selected streets amounts to one-third of the whole.

divided by the number of deaths, the average age at death is, in some wards only 14 years, and in one or two cases is reduced to 10 years, while in the Borough at large it is 22 or 23 years.

What then are the diseases which cause this great mortality of children in Liverpool? To answer this, we give a table showing the diseases and the number of deaths, caused by each disease in four years, in the selected streets.

TABLE.

DISEASES CAUSING DEATHS OF CHILDREN UNDER FIVE YEARS OF AGE IN FOUR YEARS (1867-70) IN THE SELECTED STREETS.

	Streets.							
	Rodney.	Egerton.	Henry Edward.	Adlington.	Bispham.	Lace.	Addison.	Sawney Pope.
Small Pox	..	..	..	1	1	..	1	2
Measles	..	3	3	5	4	1	7	7
Scarlet Fever	..	..	2	3	4	3	..	7
Typhus	..	..	..	..	1	..	..	1
Simple continued Fever	..	..	..	..	..	6	1	2
Relapsing Fever	..	..	..	1	..	..	..	1
Diarrhœa	1	..	3	5	7	4	3	12
Phthisis	..	1	..	..	1	..	1	1
Convulsions	..		3	9	10	3	3	7
Bronchitis	..	2	3	9	8	5	4	16
Pneumonia	..	1	3	1	1	1	5	3
Laryngitis	..	..	..	..	..	..	..	1
Atrophy and Debility	1	2	8	7	7	6	11	17
Violence	..	..	4	3	3	1	..	6
Ill defined	..	..	..	2	..	..	..	1
Other causes	2	6	9	11	9	10	9	22
Total	4	17	38	57	56	40	45	106

The mortality of children under five years is seen by the tables to be owing to five principal causes. 1st, The exanthemata, viz., the contagious diseases of childhood. 2nd, Diarrhœal affections. 3rd, Bronchitis and Pneumonia. 4th, Atrophy and Debility; and 5th, Convulsions, &c.

Taking only the six poor streets, we find that 342 children died in four years, and of these—

51	died of	Small Pox, Measles, and Scarlet Fever.
34	„	Diarrhœa.
35	„	Convulsions.
59	„	Bronchitis and Pneumonia.
56	„	Atrophy and Debility.
235		

A large number of deaths from the contagious diseases of childhood must be expected in a crowded population where removal and isolation are impossible. But the other large causes of mortality tell their own tale to all medical men; the large numbers put down to atrophy and debility and to convulsions, indicate unmistakably the greatest neglect and maltreatment on the part of the parents; while the high death rate from the acute affections of the lungs indicates as certainly insufficient clothing, and exposure, and the effects of breathing fœtid and poisoned air. From this table alone, it might be confidently predicted that the people, among whom such a high death rate occurs from these causes, are not only poor, but are careless, ignorant, and probably barbarous in their modes of life.

The table brings out another point, viz., that infantile remittent fever (in other words enteric fever) does not in ordinary years cause any considerable mortality, while the diarrhœal affections are not excessive. This probably indicates that both the drainage and water supply are fairly good.*

The great death rate of Liverpool in non-epidemic years is therefore in some measure owing to the great mortality of children.

But this will not account for all. The mortality in these streets is in excess at every age, both in comparison with all England, and with the healthy districts in England.

This is shown by the following table—

* There are other causes of infantile mortality which do not appear in the table. The smothering of infants by drunken mothers adds to the mortality, (evidence of Mrs. O'Brien in Mortality Sub-Committee's Report, p. 146, and of Mr. Roberts, *ibid.* p. 165.) No doubt, also, injuries to children have a considerable effect, which are not reported as deaths by violence.

Annual Rate per Cent. of Mortality from All Causes at Each Age at and above 5 years.

Streets.	Ages.															
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Lace	1·16	·82	·45	1·17	3·80	·46	1·79	1·96	3·21	5·10	4·61	7·43	12·50	..	..	..
Bispham	1·84	·85	..	·71	·78	1·12	1·92	1·15	3·06	2·50	3·57	1·61	..	6·25	..	25·00
Sawney Pope	1·46	1·16	1·67	3·21	2·27	3·33	4·41	2·42	5·73	7·33	4·55	5·15	28·57	16·67	..	..
Addison	1·90	·88	·41	2·03	4·17	3·02	2.70	2·63	6·25	7·14	6·25	6·43	20·83	5·00	75·00	..
Adlington	·44	·26	·31	1·47	1·22	1·51	3.45	3 67	3·98	2·36	5·43	4·63	12·50	..	25·00	25·00
Henry Edward	2.45	·67	..	1·02	1·67	·96	1·92	·86	2·94	3·75	3·95	5·00	3·57	4·17	..	..
Healthy Districts in England, both Sexes	·688	·431	·728	..	·857	..	·964	..	1·232	..	2·228	..	5·228	..	12·304	..
All England, mean of 30 years, 1838–1867 — Males	·879	·495	·790	..	·993	..	1·303	..	1·816	..	3·153	..	6·854	..	14·774	..
All England, mean of 30 years, 1838–1867 — Females	·867	·510	·822	..	1·230	..	1·230	..	1·567	..	2·856	..	5·752	..	13·536	..

At every age (except of that at 15 years, when the numbers are small, and give probably too low an estimate), the mortality is far higher in the selected streets than in the healthy districts of England, or than in all England. A glance at the numbers is sufficient to show the immense excess of death rate of these streets. An instance or two will illustrate the table. At 35 years of age, when life is most vigorous, 1,000 persons of that age in the healthy districts of England lose only 10 lives in a year, Bispham Street loses 20, Adlington Street 34, and Sawney Pope Street 44.

At 45 years of age, in the healthy districts of England, only 12 die out of 1,000 persons; 57 die in Sawney Pope Street, and 62 in Addison Street, while the lowest mortality, viz., 29 in Henry Edward Street, is still nearly 2½ as much as in the healthy districts.

We must now turn to the causes of this excess of mortality in persons above 5 years of age. In the six selected poor streets (viz., Henry Edward, Lace, Bispham, Adlington, Addison, and Sawney Pope), there occurred in 4 years 405 deaths in persons above five years of age; and the following were the chief entries in the Registration Returns.

Diseases.	No. of Deaths.	Per Centage to total deaths in persons above 5 years old.
Bronchitis	134	33·1
Phthisis	76	18·7
Simple continued Fever	22	5·4
Typhus (exanthematic)	12	2·96
Enteric Fever	2	·5
Relapsing Fever	6	1·48
Intemperance and Delirium Tremens	9	2·22
Total from these causes	261	
All other causes	144	
	405	

In Egerton Street, out of 21 deaths in 4 years, there was one death from simple continued fever, 1 from enteric fever, and none from bronchitis.

The zymotic diseases in this table give quite insignificant numbers, for the term "simple continued fever" is probably applied to any febrile state not attended with such symptoms as indicate plainly either enteric or typhus fever, or local disorder, and it therefore rather represents a class than a single disease. The great causes of mortality in these streets are lung affections; for however loosely the term bronchitis may be used, it can hardly, in the most careless returns, refer to any disease except some acute or chronic affection of the

lungs. Bronchitis and phthisis appear to be the chief causes of the mortality of persons over five years of age, in the years which are free from great epidemic disease; and in these streets, these two headings account for nearly 52 of every 100 deaths in persons above five years of age. This contrasts with the mortality caused by bronchitis and phthisis among children. Out of 342 children under five years of age dying in the same streets in 4 years, only 47 died from bronchitis, and 4 from phthisis. This is a considerable mortality, but it is nothing as compared to that in the older persons from the same causes.

If we turn to the general statistics of the town, as given in Dr. Trench's Reports, we find that bronchitis and phthisis give formidable figures of mortality; but still, these are below those of the selected streets. We, therefore, infer that, in non-epidemic years, the causes of the larger mortality in persons over 5 years living in these streets, over the mortality of the town at large, is owing to these two diseases, or perhaps we should more correctly say, classes of disease.

The prevalence of bronchitis and phthisis, as causes of large mortality, is not peculiar to Liverpool. It is marked in many other large towns, particularly in Glasgow, and enough is known to enable us to say, that it is not dependent on climatic conditions. For example, as shown by Dr. Gairdner, it is far more common in Glasgow than in Aberdeen or Perth. Its causes appear, from Dr. Gairdner's researches, not to be industrial in Glasgow; *i. e.*, lung affection there is not specially connected with inhalation of solid particles arising in the operations of trade. In Liverpool also, it does not appear to us that we can look to special deleterious occupation for its cause.

To what this high rate of mortality from lung diseases in these streets is owing will be considered when we have described the streets themselves.

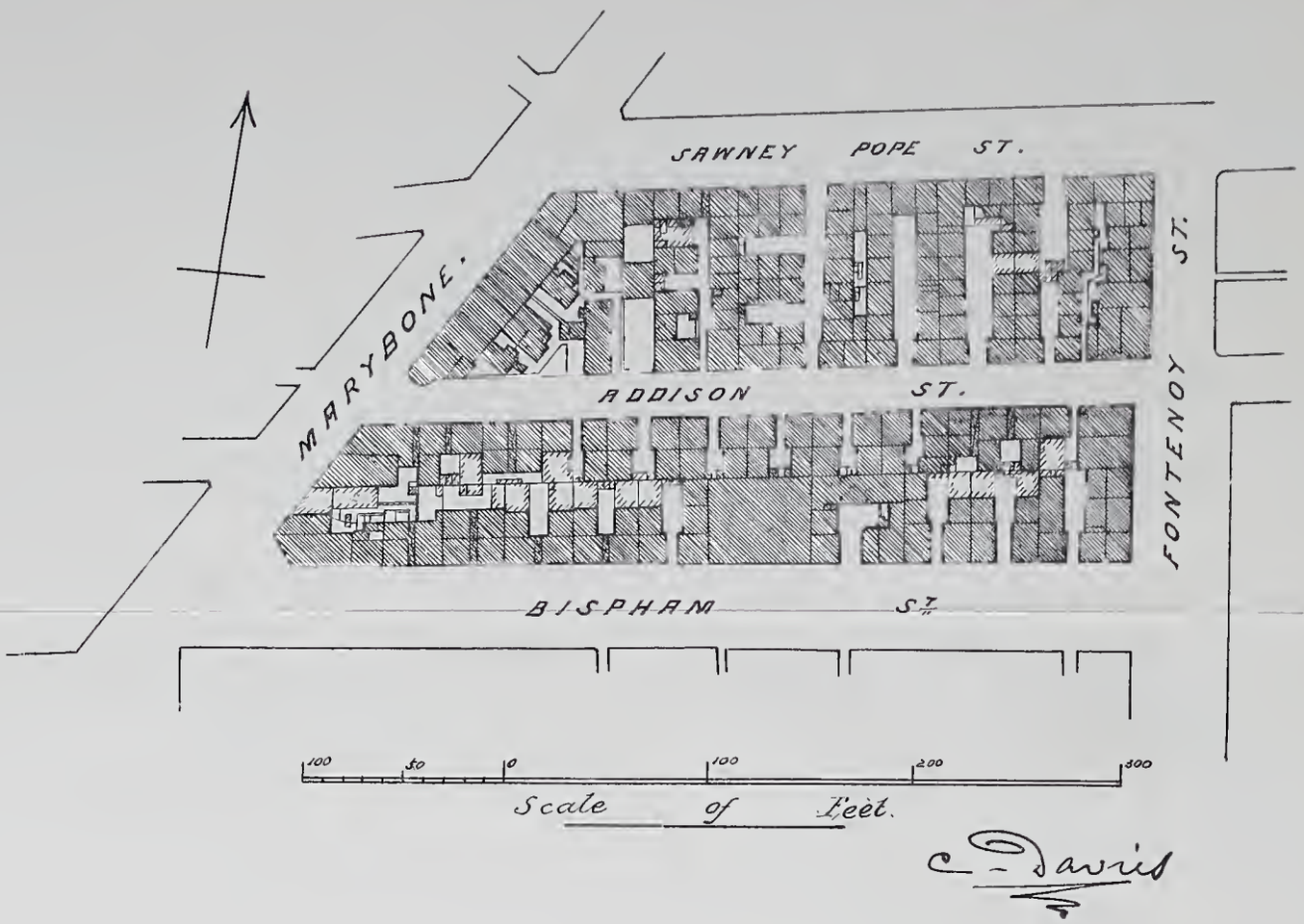
IV. The Sanitary Condition of the Selected Streets.

We made a prolonged examination of the selected streets, and of many others in the neighbourhood, and visited them by night as well as by day.

The selected streets are not in the lowest part of the town, and are from 50 to 56 feet above ordnance datum line. They are built on clay ground, from which the clay has been more or less removed for brick making, and the excavations have been, in many cases, converted into cellars.

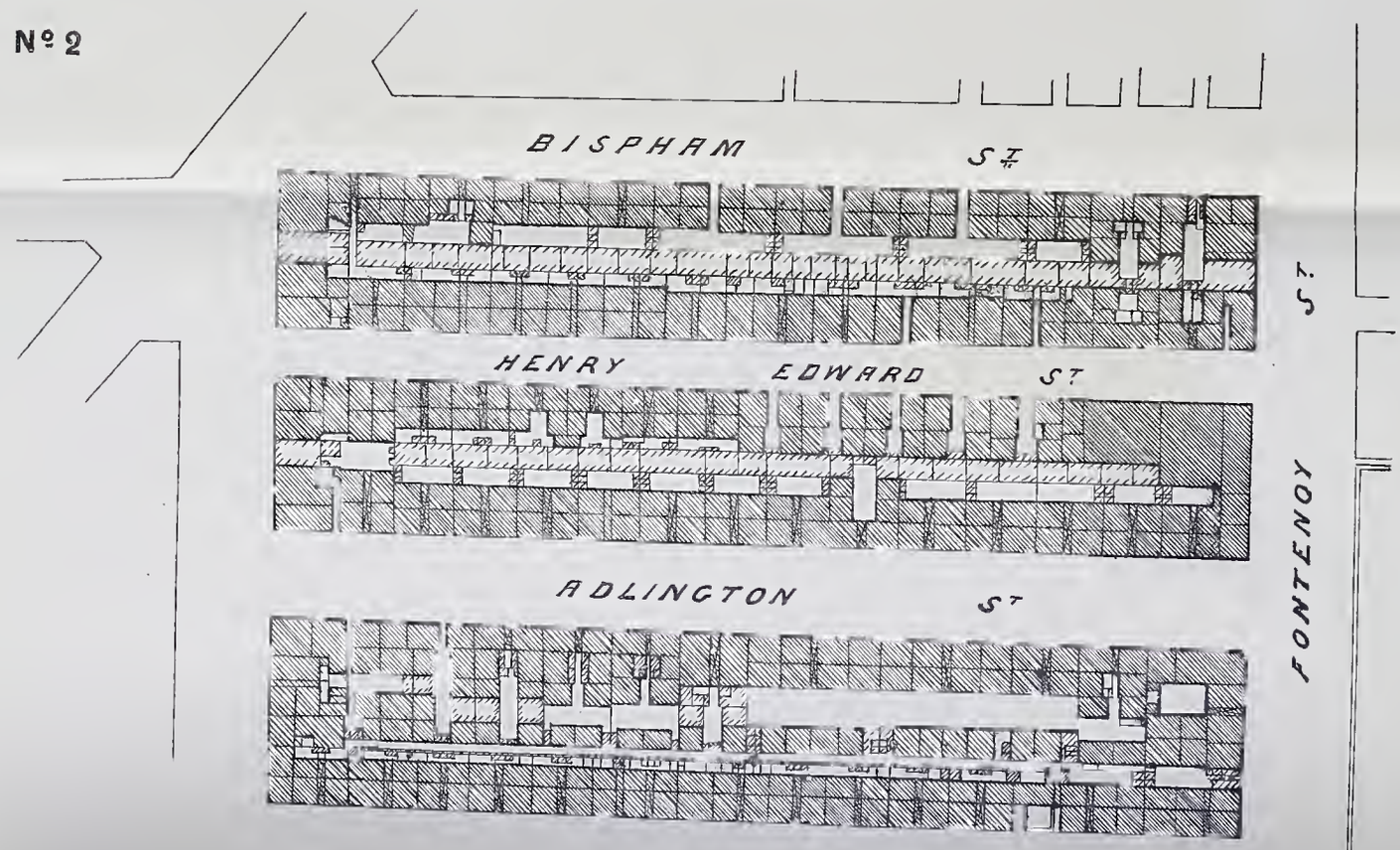
As in so many other parts of Liverpool, the streets contain the smallest proportion of the houses; the space between the backs of the houses of parallel

PLAN Nº 1



C. Davies

LAN Nº 2



NOTE: Property demolished under Sanitary Presentment Act, shewn thus

C. Davies.

streets is occupied by courts. In these courts, the houses are packed closely together with an ingenious economy of space which does credit to the builders, though Liverpool has little reason to be thankful for it.

We give a tracing showing the arrangement of the selected streets, where a population of nearly 5,000 people are crowded into a space which, at a liberal calculation, does not exceed 23,500 square yards, or the compression of the population nearly equals 1,000 persons to an acre. The red shading marks the buildings which have been removed by the Corporation improvements. The tracing shows sufficiently the arrangement of the houses back to back, the complete blockage in many cases of air and light, and the practical impossibility of thorough ventilation. Formerly, the narrow spaces in the courts were also blocked with enormous middens, which, in many cases, were close to doors and windows, but these have all been removed.

Within the courts, each house is usually found to consist of a room on the ground floor, a room above this, and a third room in the attic. Most of them have cellars. It very frequently happens that there is a family in each room except the cellar. In many cases, the staircase forms part of the rooms, and is without any window, so that, in fact, there is an inevitable mixture of the air contained in all the rooms. Few constructions could be better adapted for the spread of contagious diseases. In most houses in London inhabited by the poor, a separate staircase exists with landings, from which the rooms open, and there are windows permitting entrance of air. By this means, polluted air escaping from the lower rooms into the staircase is diluted, and more or less completely carried off; but in Liverpool, even this amount of ventilation is wanting.

The cellars in these streets are not now inhabited (though cellar habitations are found in other streets), but are either empty or used as lumber rooms. In many of them there is a water tap, and a trapped inlet to a drain to carry off the water. We have already observed, in the first part of this Report, how frequently it happens that the trap of the drain is broken or removed; and we must also notice that, in several instances, the floor of the cellar was soaked with water from the dripping of the tap, in consequence of the imperfection of the inlet. With reference to these evils, we believe that they can only be remedied by carrying out the recommendations on this subject contained in the first part of our Report (p. 19), viz., by insisting on the placing of all inlets to the sewers outside of the houses, in such positions that they can be safely inspected and repaired.

But, in addition to this, we found the floor of the cellars, in several cases, in a very foul condition. Impurities of all kinds had been deposited there, and in this way the air of the house was constantly contaminated from the basement.

As we believe that it is not possible to keep these cellars clean without constant inspection, we are of opinion that they must be so closed as to render them inaccessible to the occupants of the houses or courts. Before doing so, it will be necessary to cleanse and lime-white them; sufficient apertures (air bricks) must also be left for ventilation.

With regard to the cleanliness of these houses, it was clear that a good deal had been lately done in several houses by lime-washing the walls, and by compelling the people to clean the houses.* The epidemic of relapsing fever had probably led to this. But, in spite of this enforced cleaning, nothing could exceed the dirt of the people and the fœtid condition of the atmosphere at night. How human beings could tolerate such a state of things would be incredible, if we did not know the deadening influence of custom. The peculiar construction of the houses and the entire want of ventilation intensify the effects of this almost universal uncleanliness. For it is almost impossible also, sublet as the rooms are in most of these houses, for the people in one room to be clean while others are dirty. They give up the attempt in despair.

Accordingly, the only clean houses we saw in these courts were those in which only one or two families lived.

The causes of this fœtid atmosphere are the effluvia due to filth of the persons and clothes; the exhalations from the untrapped drains and wet filthy

* In an interview which one of us had with the Land and House Owners Association, a strong opinion was expressesd by some of the members of the Association that the habits of the people are very much dirtier now than they were before 1847. At that time the cleanly poor would insist on a dirty person removing from a court, and the owners of property were obliged to compel them to leave for fear of losing their other tenants; but now that sense of cleanliness seems lost even by the English, who were formerly very clean. This increasing dirtiness is attributed to a great extent to increasing poverty and intemperance; but, in addition to these, another cause was assigned. It was stated (by Mr. Owen Williams) that the owners are now powerless to compel their tenants to keep the houses clean, and even in some cases to pay their rent. If they attempt to do so, the tenants go to the Health Officer, and in a few days the owners receive notice to clean the houses. It was alleged by the Members of the Association, that the owners are thus put to such an expense, that they no longer dare to interfere with the tenants, and the opinion was expressed that the houses of these poor classes would be much cleaner if the owners, as in former times, were allowed to look after their tenants at their discretion.

Whatever may be the facts as regards this, it seems clear that any state of things which indirectly throws the responsibility of cleanliness off the tenants must be wrong. The inmates who allow a house to become filthy ought to pay for it, and not the owner, who may have little control over his own property. The keeping the houses in sanitary repair is another matter.

floors of the cellars; the excretions of the skin and lungs which are not removed by ventilation; the effluvia from fish and other food; and the dirt of the walls, floor and furniture when there is any.

When we visited these courts at night, it was singular how pure even the air of the courts appeared after coming out of the almost insupportable fœtor of the sleeping rooms. We ought to state that we visited these courts during cold weather, when windows are less frequently opened than in summer.

With reference to the number of persons living in these houses, a very strict supervision is maintained by the Officer of Health, and inspections are made at night at frequent though variable intervals, to see that there are not more persons sleeping in any room than the number fixed for it by regulation. Summonses are taken in all cases in which the fixed number is exceeded. This system has no doubt lessened overcrowding, and materially improved the condition of the houses. If the atmosphere is now so bad as we have described, what must it have been before this system of inspection was introduced?

The lodging-houses which are all ventilated and kept clean, presented a considerable contrast to the houses in these courts. The air was comparatively pure, and we saw the lowest kind of tramps sleeping in rooms far healthier and cleaner than the houses of dockyard and other labourers.

With regard to the people and furniture in these houses, we were not at all prepared either for the wretched appearance of the people, or for the terrible aspect of poverty disclosed.

All this is so familiar to the Town Council and to the Officers of Health, that we feel we are going over ground too well known. But it is necessary to the completeness of our sketch to state, that we could not have believed that in any town in this country we could have gone into room after room, and house after house, and have found in so many cases literally almost nothing but the bare walls, a heap of straw covered by dirty rags, and possibly the remains of a broken chair or table. In London, and every large town, such rooms may be found, but the peculiarity of Liverpool is, that they are so numerous. Of course there are houses and rooms fairly furnished, and we are not able to give a numerical statement of the relative numbers of these unfurnished rooms, but in one or two streets, and in several courts, they were, we think, in the majority.

We were much struck by two circumstances in these houses, in addition to the want of furniture. There were no cooking utensils of any kind, or only

an old saucepan. The inmates then depended for the means of rudely cooking what food they could get (in our visits chiefly fish and bread) on a neighbour's kindness. The second point, was that it was evident many persons had no change of clothes. On pressing the enquiry as to how they washed, and what they did at night, we extracted from several that they occasionally washed their hands and faces at the tap, but seldom removed their clothes. In some cases, both of men and women, we made out that the clothes had not been removed for several weeks. In our visit at night, we sometimes found that the clothes had been partly removed, and were then drawn over the person. Some men, indeed, were in bed quite naked, lying on the straw, and covered with their clothes.

The influence of such a mode of life as this on health in general, and in particular on the propagation of typhus and other contagious diseases in this way, need not be insisted on.

The impression made upon us by these circumstances has been so deep, that we may unconsciously exaggerate their frequency. It must be remembered that we are referring only to the worst parts of the town, and we should be sorry to apply this description to the houses of the mass of the labouring population in Liverpool. But certainly we can safely say, that the relative number of these houses, and of the people living under these conditions, is much greater in Liverpool than in other towns of which we have knowledge.*

With regard to the causes of this condition of the people, all to whom we have spoken attribute it to three circumstances: the irregularity of the labour market, the improvidence and careless habits of the people, and especially of the Irish, and the great intemperance.

On this last point we are aware that numerous investigations have been made in Liverpool, and that no additional evidence is needed from us. But following our course of independent enquiry, we endeavoured to make out what part intemperance played in producing this poverty and all its attendant evils. We cannot doubt that it plays a very large part. We have, in our note books, the replies given by many of the poor people whose rooms we entered. Many of them at once attributed their condition to drink; others owned it on being pressed on the matter. Several women gave an exact statement of what their husbands earned, and what they brought home. We select two examples of

* Dr Trench, in his Annual Reports, has directed attention to another point on which we did not specially collect evidence, viz., the number of adults of the two sexes, fathers and daughters, mothers and sisters, or strangers, sleeping in the same room, and often in the same bed. This is a feature of all our large towns, and is well known to be a most fruitful source of evil of all kinds. It is unnecessary to do more than to allude to it.

workmen, in whose cases there was no irregularity of employment. A tin-plate worker in constant work earns 22s. a week. He has a wife, evidently a careful respectable woman, and four children. In reply to questions, she said he drank a little, then owned "he drank very heavy." "Sometimes he brought home 18s., sometimes 16s., sometimes 12s.; last week he drank it all. If he would bring 22s. a week, she should be happy as the day is long." This family (six persons) were living in one back room, for which they paid 1s. 6d. a week; it was 10¼ feet long, 9 feet broad, and 8¾ feet high; the furniture was a bed, table, and two ricketty chairs. Two of the four children were sick. In the front room of the same house, the rent of which was 2s. a week, a man and wife, a daughter aged 17, and a son aged 15, lived; the man earned 24s. a week, and passed his time in drinking hard, repenting and saving, and then drinking again; the wife "drank all she could get." The son and daughter earned next to nothing.

Here we have two cases, of constant employment and good wages associated with utter poverty, to end, no doubt, in relief from the rates and death in the workhouse.

When the occupation is uncertain, like that of the dockyard labourers, the case is nearly the same; the temperance, which is enforced from time to time by destitution, is compensated for at the first opportunity on the return of plenty.

Instances of this kind seem to occur so frequently in all the poor districts of Liverpool, that we question whether 20 per cent. of the labouring class in these streets are leading lives of ordinary restraint and decency.

It does not appear that the bad trade of the last few years has lessened the amount of drinking: all agreed that there is much more than formerly.*

In order to form as correct an estimate as possible of the amount of drunkenness in certain parts of Liverpool, we applied to a source on the accuracy of which we place the greatest confidence, although we are not permitted to name it.

Data connected with most of the houses in one of the apparently most

* In order to collect evidence, we applied to various parties, and, among others, we were advised to apply to a man who had been a landlord of a small public house in one of the selected streets. He had lived for years in the district, and knew intimately the habits of the people. He told us that "for one man who did no drink, there were 50 who would take their share; they starve their wives and children, and must beg if they want a bit."

destitute streets were submitted to us; the large wages which can be earned with comparative regularity, and the amount which is spent in drink, are astonishing. One or two instances of the worst kind (if there is really any distinction) occurring in the same street may be cited.

A man earns 27s. regularly, and spends as regularly 21s. in drink; his four children are in rags.

In another instance, the wages are 30s. a week regularly; the father and mother are both drunken, and three children are half starved, and in rags. In another house is a copper ore worker, earning 27s. a week, all of which is spent in drink by himself and his wife. The children are in rags and filth, and look idiotic. In the same street, there are sober men, earning only 20s. and 23s. a week, who are living in comfort.

It is not surprising that our informants, who, as we stated, have the fullest information on the habits of the people, say decidedly "that drink and immorality are the two great causes of the mortality."*

We have, then, a population who are living in houses originally badly planned, and very closely crowded together, and who are placed, partly by their own faults, partly by circumstances, in conditions which necessitate their breathing an atmosphere which is highly fœtid from several causes.

The unhappy people seem to know none of the comforts, and few of the decencies of life, and widespread habits of drunkenness, and consequent want of food, aid their wretched homes in destroying their health.

Add to this, that, in accordance with the usual habits of Irish Catholic population they marry early, being induced by the advice of their priests to do so in preference to living in concubinage.

* We also applied for information to the Liverpool and Birkenhead Temperance Band of Hope Union, and were favoured with a very careful report on the subject. Among other points the Report states, that in an enquiry specially directed to this point, no single instance was met with of a really steady man not being in regular work; that those who are in irregular work complain of the want of societies to which they could subscribe when in work, and thus obtain relief when out of work. But it is added, that many workmen think such societies could not be made to answer, or would be abused if established.

In some of the streets investigated, in answer to our question by this Society, it is stated that at least half the families are in the condition of drink and poverty already described, and that the number of strictly sober families is very small. And we are quite satisfied, from our own enquiries, that in the streets we went through this proportion is really under the mark.

On the subject of intemperance, there is also much evidence given by various witnesses before the Mortality Sub-Committee of 1865, to which we need not do more than refer. But it bears out everything we have asserted.

In spite of the heavy mortality among the children, the proportion of children is therefore not smaller than in other populations, and so, year after year, there goes on an immense production, and as great destruction, of human life.

When, from the houses, we pass to the condition of the courts outside, it is impossible not to be struck with the contrast. Here the work of the Corporation is seen at once. Most of the courts are well paved; many have stand-pipes for the supply of water (and which at the time of our visit was always on); and galvanised iron receptacles, in which all the dry rubbish of the house is put, are placed in convenient situations. Almost every court is well drained. On laying bare, and opening two court drains selected by ourselves, we found that they were in perfect order, and that their channels were clear and entirely free from deposit.

In many courts, walls, buildings, and even whole houses, have been removed during the last few years for the admission of light and air, and in this way a work of sanitary amelioration has been accomplished by the Corporation, with the magnitude and importance of which, we cannot refrain from remarking, that we were very strongly impressed. Still, of course, the essential features of the labyrinth of courts remain, and can only be removed by demolition on a much larger scale.

Middens have now been practically abolished throughout the greater part of Liverpool. In all of the courts of which we have been speaking, trough water-closets have been constructed in their place.

As these trough closets have been the subject of much discussion, we have made careful enquiry as to their actual condition and working.

As an apparatus for the speedy and safe discharge of large quantities of excreta into a drain, we regard the trough closet as superior to any other with which we are acquainted. So long as the trough is full of water, the solid matters which fall into it are completely covered, and are flooded away into the sewer at the moment that the trough is discharged, as we ascertained by personal observation, in the most efficient and complete manner. Obstructive objects of an improper kind, introduced by carelessness or mischievous design, are easily removed by the scavengers in charge, so that, blockage of court drains is an uncommon occurrence. The troughs are of extremely simple construction, not easily deranged, and can be worked at a comparatively small expense; for all which reasons they are better adapted for a population such as that of the Liverpool courts than any other form of water latrine.

In turning our attention from the troughs themselves to the woodwork covering them, we met with the same contrast already noticed, as existing between the interiors of the houses and the drainage. It is sufficient to say, that the seats were, as a rule, in a state of disgusting filthiness. This was attributed partly to the loss or absence of the keys which had originally been provided, but principally to the habits of the people, with reference to which it may be noted, that a practice prevails pretty extensively, which, in itself is sufficient to account for all that we observed. It appears, that the adults, both male and female, often use the seat by standing on it. On enquiry, we were told that they do this from fear of infection. Whatever may be the real foundation for the fear, the existence of the custom affords evidence of the widely spread fear of venereal diseases which exists among the lowest classes.

In many courts, we observed that the evidences of the negligent dirty habit to which we have referred, extended not only to the closets, but to the pavement. Much is done to counteract this by the vigilance of the officers of the Corporation, but at best inspection can do little, as opposed to the barbarous habits of a half civilized race. We presume that the evil must remain unremedied, until either the people are better instructed, or can be made personally answerable for their neglect.

We determined the effect on the house drains, of the process of discharging the troughs; in the courts in which we opened the drain, it was seen that, though during discharge, the flow was rapid, the quantity flowing at any moment was never sufficient to fill the drain-pipe, so that it could not act as a piston. In the cellars in this and in other courts, when the taps were in order, we could not detect that any air was forced back through the traps, when the trough closet was emptied. In those cellars where the traps were deficient or ineffective, the emptying of the trough closet caused an inconsiderable draught, which was chiefly from the cellar into the drain. In some cases it was at times reversed, but the inflow seemed always greater than the outflow.

In addition to the advantages possessed by trough water closets as arrangements for those courts, in which it would be manifestly impossible to provide a separate convenience for every dwelling, we would refer to another point in connection with the trough closets, to which we are inclined to attach considerable importance. In the presence of an epidemic, either of enteric fever or cholera in a court, it will be easy to put disinfectants into the trough water closets, and thus to destroy the noxious power of the discharges before they

enter the sewers. We strongly advise that this should be done, in case cholera should again visit us.

With respect to the water supply of these courts, the pipes were always full during our visits, but we believe that, for a certain number of hours daily, the supply is cut off; we observed that there was much waste, many of the taps were dripping or were allowed to run. As the supply is not really constant, the people collected it in vessels, and kept it in their rooms or cellars. This is a point, however, on which we need not enlarge, as we believe everything is being done that can be in this direction.

It seemed to us impossible but that the people should gradually become more cleanly, with water thus brought to the very threshold, or into every house.

We have already alluded to the necessity of taking the water tap out of the cellars; when it is put there, it necessitates a drain to carry off the water, and then the house may receive sewer air through a broken trap. It would be much better to have the taps always outside, and if stand pipes, and contrivances for preventing the waste of water were used, it is possible that the waste might be greatly lessened, and enough water be found to give a supply which is constant in the true sense of the word.

If we now bring into comparison the facts before ascertained, as to the nature of the diseases which from year to year yield the high mortality in the selected streets, and the conditions under which we find the people living, we do not conceive that much mystery can remain as to the causes of the high death rate. It is no wonder that the contagious diseases spread in such a closely packed and foul population, and in houses of such a construction. Nor can the delicate frames of children be expected to withstand the effects of such an atmosphere, and of the deprivation of warmth and food, which the drunken habits of one or both parents bring upon them in so many cases. The industrial habits of all our large cities are well known to militate against the lives of children; and the cotton famine taught Lancashire the lesson, that want of work and of wages may really lessen the mortality of children by preserving to them the mother's care. In Liverpool, this cause no doubt is also acting, but, undoubtedly, the most potent agencies in destroying infant life are the conditions above noted. Hence the significance of the terms "atrophy and debility," which occurs so often in the mortality tables as prevalent causes of death in the first five years of existence.

The increased mortality of persons over five years of age is also easily

explained. The conditions which formerly in the army gave rise to an extraordinary fatality from diseases of the lungs, exist in equal intensity in these streets. In the year 1838, the Reporters of the Statistical Returns of the Army discovered that, among the strong infantry soldiers of the guards, lung diseases caused no less than 67·7 per cent. of the total mortality, and after an investigation into the possible causes, they considered that the main factor of this result was the foul atmosphere produced by overcrowding. The gradual removal of this condition has resulted in a corresponding diminution of fatal lung diseases in the army, which is the strongest proof of the correctness of the explanation. No doubt, in the case of the inmates of these Liverpool houses, there are co-operating causes; under-feeding and exposure, the necessary results of intemperance, doubtless play their part, and in some cases, special warehouse and factory work may assist the result. But considering how many of the men in these streets are dockyard labourers, and are often employed in the open air, we cannot but attribute the main result to the condition of their houses.

What exact share the sewer air when it enters houses plays in this direction we cannot tell. No doubt it helps in the result, but we must also admit that the returns for four years of the deaths in the selected streets do not give any striking evidence of the prevalence of diseases, such as enteric fever, or fatal diarrhœa, which are often traced back to the effluvia from sewers.

The following table will show this.

Street.	Population, all ages.	Deaths from enteric fever in 4 years, all ages.	Deaths from diarrhœa in 4 years in persons over 5 years of age.	Deaths from diarrhœa in 4 years in children under 5 years of age.	Deaths from simple continued fever in 4 years, all ages.
Bispham	716	..	..	7	1
Sawney Pope	1016	1	3	12	8
Addison	688	..	..	3	3
Lace	715	1	1	4	12
Henry Edward ..	677	..	..	3	3
Adlington	936	..	..	5	4
	4748	2	4	34	31

In this return of enteric fever and diarrhœa, it is impossible to trace any bad effect of sewer air; but if we suppose that cases of enteric fever were returned as "simple continued fever," then it is found that 4,748 persons gave annually eight deaths. So that, even if these were all cases of enteric fever, the proportion would still be trifling. But 9 of these 31 fatal cases in four years of "simple continued fever" were in young children, and, doubtless, these, and many of the cases in adults, represented several diseases, and not simply enteric fever. We have then no hesitation in saying that, in these six selected streets, the usual diseases which, so to speak, are the test of the presence of sewer air and only inefficient drainage, were present to a very small extent. Without denying some influence to sewer air, we are yet thrown back on the other causes of foulness of the air in the houses to principally account for the high mortality from lung diseases, and these causes are, in our opinion, quite sufficient.*

To push this analysis further is unnecessary. We have now examined the most authentic statements we could procure of the diseases causing the mortality in non-epidemic years, and we have had no difficulty in accounting for the excess of deaths. We can perceive no flaw or ambiguity in the results, nor have we the slightest hesitation in expressing our belief that these six streets represent fairly the condition of the numerous streets which more or less closely resemble them.

RECAPITULATION OF THE CAUSES OF THE MORTALITY IN LIVERPOOL.

1. The death rate of Liverpool may be divided into the extraordinary and the ordinary.

2. The extraordinary death rate prevails in those years in which there is an unusual spread of certain epidemic diseases, viz. — Typhus, Small-pox, Cholera, Relapsing Fever, &c.; and, among children, Scarlet Fever and Measles. Enteric fever does not appear to be very prevalent in Liverpool, and has not assumed the proportions of an epidemic for several years.

* This result shows that the condition of affairs in Liverpool in this direction must have very much altered since Dr. Duncan wrote his important essay (on the Physical causes of the high rate of mortality in Liverpool, by W. H. Duncan, M.D., First Report of the Health of Towns Commission, 1844, p. 122). His remarks on fever chiefly refer to Typhus exanthematicas, which was not at that time distinguished in the returns from enteric fever, and is not closely connected with sewage. But making allowances for the better distinction of diseases which can now be made, there is no doubt that enteric fever must have then prevailed more commonly. We infer, therefore, that the improved sewerage has done good in this direction.

In reference to Dr. Duncan's Reports, and others, we cannot help remarking how little the lessons is experience taught, and in how small a degree the advice of the Physicians of the town in 1802, on the construction of streets and courts, influenced the authorities.

Owing to the position and trade of Liverpool, there is always danger of the introduction of these diseases when they are prevailing elsewhere. It is therefore necessary to adopt measures, as far as can be done, for isolating emigrants from the stationary population, and for removing, as early as possible, persons affected with any of the above diseases from among the population, either fixed or migratory. Hospitals for these epidemic diseases should be always ready, and the measures now adopted for disinfection of clothing and houses should be energetically carried out and extended. It may be considered certain that Cholera, Typhus, or Relapsing Fever, or any other disease capable of being carried by human beings, will almost certainly be introduced into Liverpool, if it prevails epidemically in North and North-Western Europe, or in Ireland.

3. The ordinary mortality, *i. e.*, of the years without widespread epidemic diseases, may be considered as regards,—

(*a.*) Persons under five years of age.

(*b.*) Persons over five years of age.

In the former case, the mortality is chiefly referrible to five classes of diseases, two, if not three, of which indicate with certainty that the conditions in which the children are placed are in the highest degree unfavourable to them, and are so in consequence, chiefly, of the improper management of the parents. Exposure to cold, improper and insufficient food, and the breathing of highly impure air, are evidently the main causes of the mortality, and arise from the ignorance, neglect, and, in many cases, drunkenness of the parents.

The excessive mortality in persons over five years of age is not owing, in ordinary years, to the widespread prevalence of the zymotic diseases, but is mainly caused by diseases of the lungs, which proceed, doubtless, from several co-operating causes, among which must be placed in the first rank the foul atmosphere of the houses in which so many of the labouring class of Liverpool live. Insufficient clothing and scanty food—the result, in many cases, of intemperance, or of irregular employment—are doubtless powerful aiding causes. The statistical returns of four years from six selected streets, with a gross population of 4,748 souls, do not show any decided evidence of improper sanitary conditions of either water supply or sewerage; but the entrance of sewer air into many of the houses is quite certain, and must contribute to the fœtor and unwholesomeness of the atmosphere, which is the main sanitary defect in the poor houses of Liverpool.

The remedies are to be sought, first, in the introduction of greater volumes of pure air among the crowded quarters, and into the houses of Liverpool; and, secondly and chiefly, in the improvement of the morals of the people, and in the cultivation of habits of temperance, self-restraint, and forethought. The improvement of the ventilation of the houses in Liverpool is a comparatively easy task; but the restraint of intemperance, and the regulation of labour, are matters which will tax to the utmost the skill and determination of the people of Liverpool.

GENERAL STATEMENT OF PROPOSED MEASURES.

For the amendment of the moral and physical evils which the existence of a degraded population in her very midst entails upon Liverpool, the powers of the local authority are at present limited to the abatement of overcrowding; the carrying out of certain constructive improvements; and to enforcing on owners the maintenance of their houses in a state of sanitary repair and cleanliness. Work of this kind has been already so efficiently carried out, under the advice of your present Medical Officer, and his predecessor, the late Dr. Duncan, that we do not desire to suggest any new course of action in this direction. We desire to record our strong conviction that these measures ought to be energetically prosecuted; and, in particular, that the clearances which have been so judiciously made, under the provisions of the Local Sanitary Act of 1864, should be still further carried out.

But we must not conceal our belief that, to make Liverpool as healthy as it ought to be, larger measures are required. No one can look at a map of Liverpool, or calculate the density of the population,* without being convinced that, in some way, surface overcrowding should be lessened. In other words, there should be effected some displacement of the population.

In stating this principle, we have perhaps gone as far as we can, for it must be for the Corporation to determine in what way it should be carried out. So many circumstances of public convenience, expense, and possibility of obtaining powers must influence the decision that we fear to embarrass the Corporation by attempting to give any definite recommendations. We will, however, say a few words, for the purpose of defining our meaning, and of showing how some displacement of the population may, we believe, be effected.

* Thus, Dr. Trench's estimate is, that there are 99·3 persons per acre in Liverpool, and only 41·2 in London, 36·6 in Bristol, 42·7 in Hull, and 80·8 in Glasgow.

But, of course, in special parts of the town, the crowding is far greater, as in our selected streets, where nearly 1,000 persons dwell on one acre.

It is impossible for the Corporation to provide houses for its poor citizens. That would be simply offering a premium to pauperism. But it appears to us that great aid would be given to those who can provide houses* by two measures, which may properly be carried out by the municipal authorities.

The first step for the improvement of the wretched houses of Liverpool must be the bringing pure air into the midst of the crowded quarters. This can only be done by opening wide and straight streets in such directions, and to such an extent as may be determined after consideration of all the circumstances. If gradually carried out, this would displace the population from some part of the worst quarters, and would prepare the way for improvement of the houses that remain.

The second step would be an adjunct to this. As the object is to spread the population over a wider area, some of the workmen will be at a greater distance from their work than at present. This must be met by facilitating means of transport, by which the difficulties of distance are removed. The conditions of urban and suburban life have been totally altered, in the life time of the present generation, by the use of railways, tramways, river and road steamers. Advantage should be taken of these agencies for sanitary work.

If improved means of transport can be combined with the formation of new streets, so as to let the workmen be practically as near his work as he was previously, the inconvenience inflicted on those who are obliged to move would be moderate and transient, while the benefit to all would be great and permanent†.

With regard to the expense of such improvements (which, of course, would be gradually carried out), we may safely say that no expense can be so heavy as that produced by a constant yearly mortality so great as that which prevails in Liverpool. It is certain that sickness is the most costly of all things, and on this ground alone we advocate this proposal. But we would advocate it on higher grounds than its ultimate money advantage. It is incumbent on its

* "We are glad to find that there is a movement on foot in Liverpool (in which your Medical Officer of Health has taken an active interest), the aim of which is to alter the condition of the labouring classes in Liverpool, by improving their home arrangements. It is proposed to do this by two methods: by the erection of blocks of model houses for families, and by purchasing property in the worst districts of Liverpool at a fair but moderate price, effecting a few structural alterations, and placing the houses in good and serviceable repair. We think the latter of these two proposals to be of as great sanitary importance as the former.

† This displacement of the population, from the densely crowded parts of the town, was advocated many years ago by Dr. Rumsey, of Cheltenham, and appears to us to be the true remedy for the condition of the people in many of our large cities.

authorities to remove from Liverpool the great opprobrium of being the most unhealthy town in England ; and surely some sacrifice, if needed, will be made to secure to the poorer citizens, as far as public action can do it, the inestimable blessing of health.

In recommending the construction of new streets, we are well aware that the powers actually vested in the Corporation are inadequate for the purpose. It would be necessary to obtain powers from Parliament, in the same manner as for any other public object. It should be distinctly understood, that, although the alterations we contemplate would no doubt be advantageous in many other respects, the end for which we recommend them is exclusively for the improvement of the public health ; and the Corporation, in disposing of the land purchased, should be guided entirely by sanitary considerations. We would recommend, for example, that any land which the Corporation might have to dispose of should not be used for the erection of lofty buildings, such as large warehouses, which, by obstructing the free circulation of air, would rather hinder than promote one of the main objects in view ; but exclusively for the construction of dwelling houses for the working classes; and the conditions of disposal should be of such a nature as to ensure—

(1.) That the houses should be constructed under the immediate supervision of the officers of the Corporation, as regards drainage, ventilation, and general plan ; and

(2.) That they should be maintained in sanitary repair, under strict regulations.

By this scheme, and by persevering with the measures in force, a great improvement would in a few years take place in the ventilation of the houses in the crowded quarters; and we are confident that there would be a commensurate and material improvement in the health of those living in them.

After this great sanitary measure has been maturely considered and set in movement, there remains, perhaps, the most difficult question of all, How can a disorderly and drunken people be made to understand the injury that they inflict on themselves, on those dependent on them, and indirectly on all living near them ? How can drunkenness be lessened, labour regulated, and habits of care and forethought made to take the place of the reckless and barbarous life which runs through a brief career in the crowded courts of Liverpool.

With such habits and such a reckless disregard of the commonest rules of health, it would be marvellous indeed if the death rate were not high.

It is not for us to discuss remedies for evils, which the sagacious men who govern the city of Liverpool are far more competent to deal with than we are. We are not bringing to their notice for the first time the amount of drunkenness and consequent destitution which exists. These things are but too familiar to them, and some of the Town Council may perhaps think we have not drawn the picture in lines deep and sombre enough to express the reality. We will not presume to indicate the remedy for these evils, but we will venture to say, that we think it impossible that those great employers of labour who show such remarkable talents for organization and administration, should not be able to deal also with the problem of the foul social life which many of those who labour for them are leading.

Surely, if a combination of masters were ever justifiable, it would be in this case. The regulation of intemperance and of labour can, after all, present no insuperable difficulty, if the existence of the evils we have noted has been fully realised. The difficulty arises from the opposition of those who do not believe what is stated, or who believe improvement to be impossible, and are content to let things take their own course. To any such persons we would suggest that, in a question of such vast importance as this, they should not rest satisfied with simply denying or ignoring the existence of the excessive vice and destitution of parts of the town. They should examine for themselves; and we have then no doubt they will not fail to recognise a state of things, which if not righted, will eventually, in some way or other, right itself, perhaps at the expense of the whole community.